



All systems go
Transforming Australia's
economy to grow
July 2022

Foreword

Climate change is a defining issue of our time, posing significant challenges to global economies and future generations as we seek to protect our planet.

Australia's decarbonisation journey is underway, with many businesses cutting their greenhouse gas emissions and governments moving to legislate targets to achieve net-zero by 2050.

With increasing certainty and commitment to this target, it is now helpful to quantify the scale of investment required and the optimal path to remain a strong and growing economy.

All Systems Go, a new report commissioned by NAB, highlights that \$70 billion in structural changes is required over the next decade and \$420 billion in new investment is needed over the next 30 years to position Australia's economy for growth in a low emissions world.

To put this in perspective, the scale of action needed is far broader than the Industrial Revolution and the timeline is roughly half.

Achieving net-zero is a system-wide economic challenge, where capital will be reallocated from emissions intensive assets and to low emissions technologies.

Higher-emitting industries are making huge investments in clean energy sources, more efficient processes, and modern technologies.

However, the transition will not be successful if it is left to power companies and fossil fuel extractors to solve alone.

The Australian economy is an interconnected and dynamic system, where change will impact every business and every household, and we will all need to adjust.

This report examines the coordination required across the critical systems of energy, raw materials manufacturing, mobility and food and land use.

It demonstrates that climate action is everyone's job and that we need action from business, government and the broader community.

As a nation, we're making progress but there is much more to do:

- We need more businesses across the economy (and we will be doing this also) to demonstrate a good understanding of their emissions and to report in a simple and standardised way. Consistency means clarity and transparency on progress;
- Co-investment between governments, business and industry will be pivotal to accelerating the development of new low, zero and negative emissions technologies. For example, a commercially viable hydrogen market is a priority for heavy industry in Australia, and we'll play our role supporting the growth of this critical industry;
- While emissions reduction needs to be the primary mechanism to achieve net-zero, Australia is uniquely placed to expand its carbon offset market.



With Australians facing more frequent and intense natural disasters, slow or no action will impact homes, businesses, and communities. Our economy will become globally uncompetitive and our environment increasingly unsafe.

NAB is working with our customers to understand the steps they are taking to evolve their businesses, including providing finance, to capitalise on opportunities in a net zero world.

We have a critical role to play in funding and supporting the transition.

Transforming Australia to a low carbon economy is inevitable and complex. If we get it right, the opportunities are immense. NAB is backing businesses to realise that opportunity, hence our interest in the contents of this report.

Philip Chronican
Chair, National Australia Bank.



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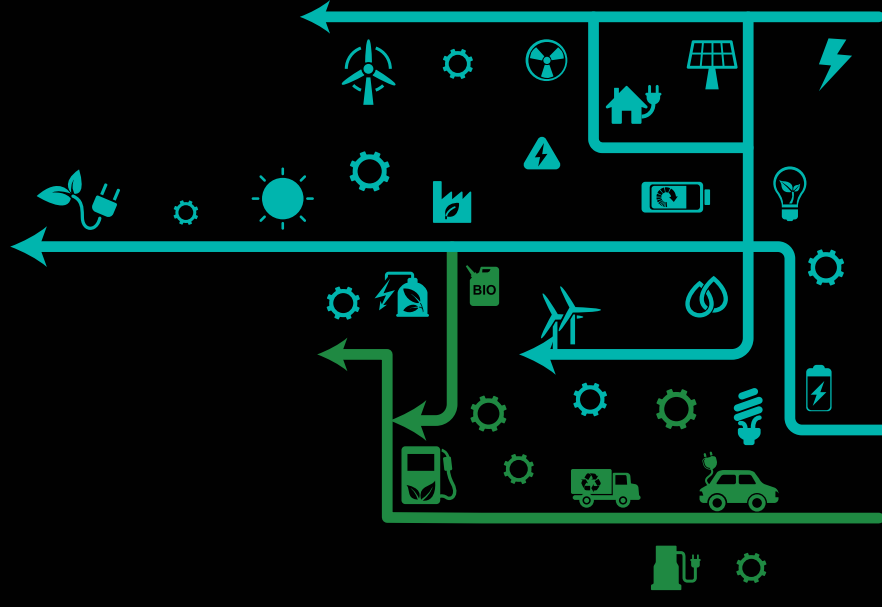


This report has been commissioned by National Australia Bank Limited and prepared by Deloitte. NAB has commissioned this report to quantify the structural changes and new investment opportunities over the next 30 years to position Australia's economy for growth in a low emissions world. All findings and views expressed in the report are that of Deloitte.

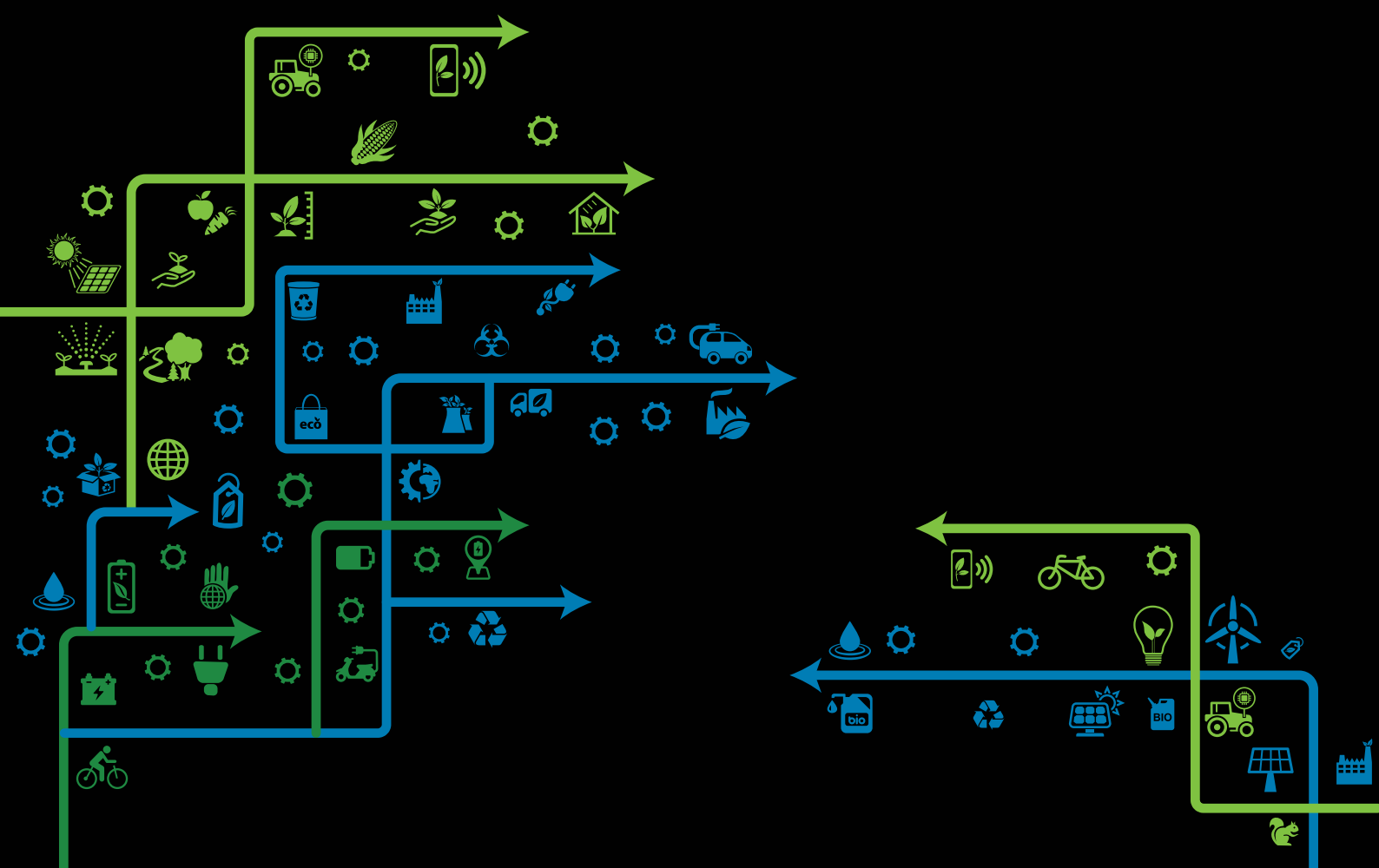
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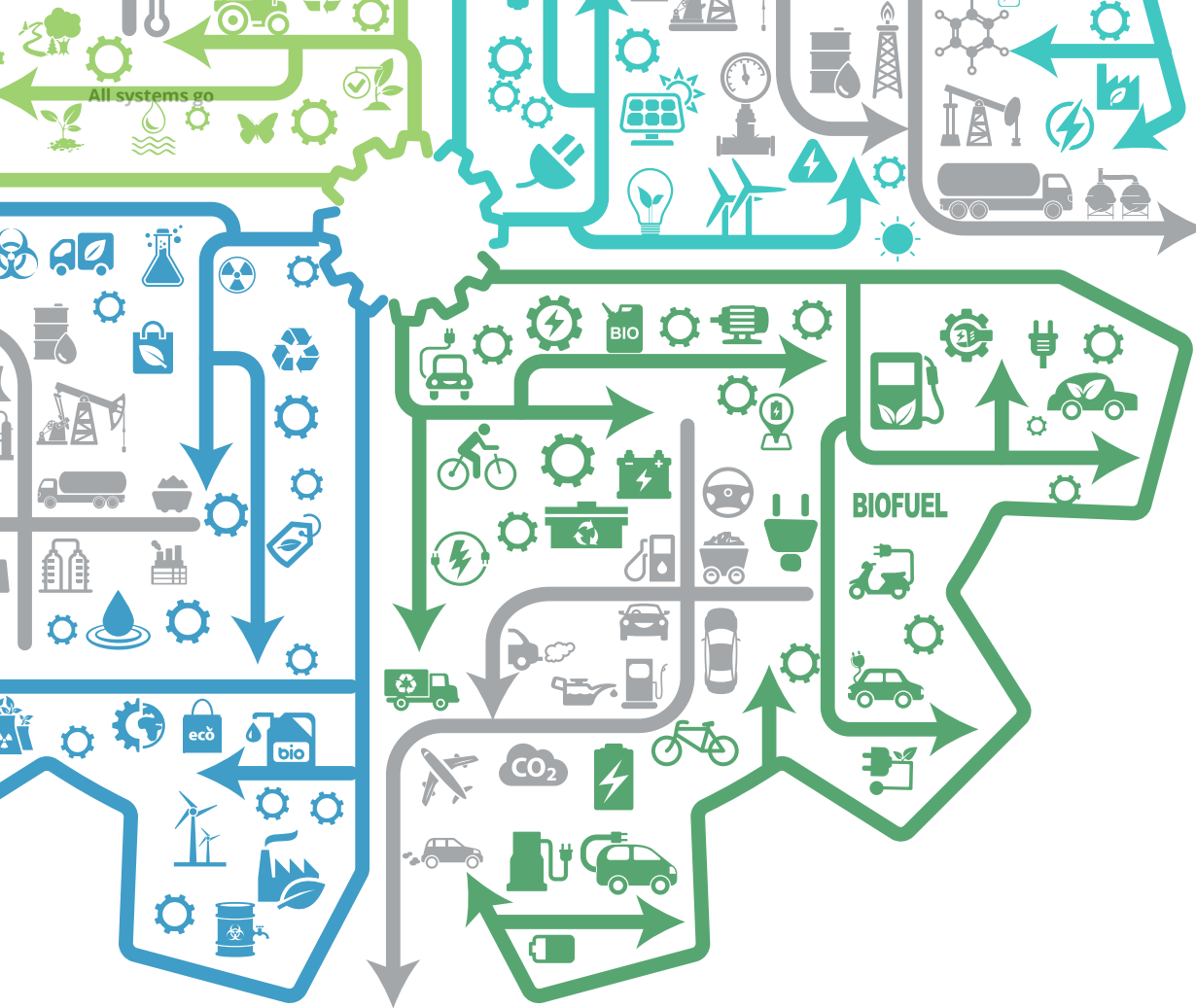
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Insight summary





Decarbonisation of Australia's economy is inevitable. As global trade, technology, capital markets and regulation all hasten towards a low-emissions future, the big question is; what will it take for Australia to realise the immense economic opportunity in transition and to emerge as a leader in low-emissions industry.

If coordinated and early action is taken towards Australia's decarbonisation, the economy stands to gain around \$890 billion over the next 50 years.ⁱ This is in comparison to a future of no further or significant climate action, which could result in \$3.4 trillion in economic losses, over the same period.ⁱⁱ

Getting to net-zero will require whole-of-economy change. Every business in every industry will have to evolve. Every household will need to make changes. Australia's transformation to a low-emissions economy requires us to make changes to operations, technology and the economic foundations that have fuelled Australia's modern prosperity.

Importantly, Australia's transition will require new investment and a shift in where capital investment flows. It calls for a 'Great Reallocation' of capital investment that will become the business of this decade, facilitated in large part by Australia's financial system.

This report builds on existing research to reveal what it will take, in economic terms, for Australia to reach net-zero by 2050. It quantifies the new investment needed and the reallocation of capital away from emissions-intensive assets and towards low-emissions technology. Above all, it highlights the biggest shifts that need to happen in the next decade to maximise the economic dividend of a transition that is inevitable.

These changes are necessary and new areas of opportunity for Australia. If done right, decarbonisation is an opportunity to set Australia on a new, stronger economic trajectory that will secure prosperity for future generations.

ⁱ Net present value from Deloitte Access Economics analysis for the Business Council of Australia (2021).

ⁱⁱ Net present value from Deloitte Access Economics analysis for the Business Council of Australia (2021).

A new wave of investment

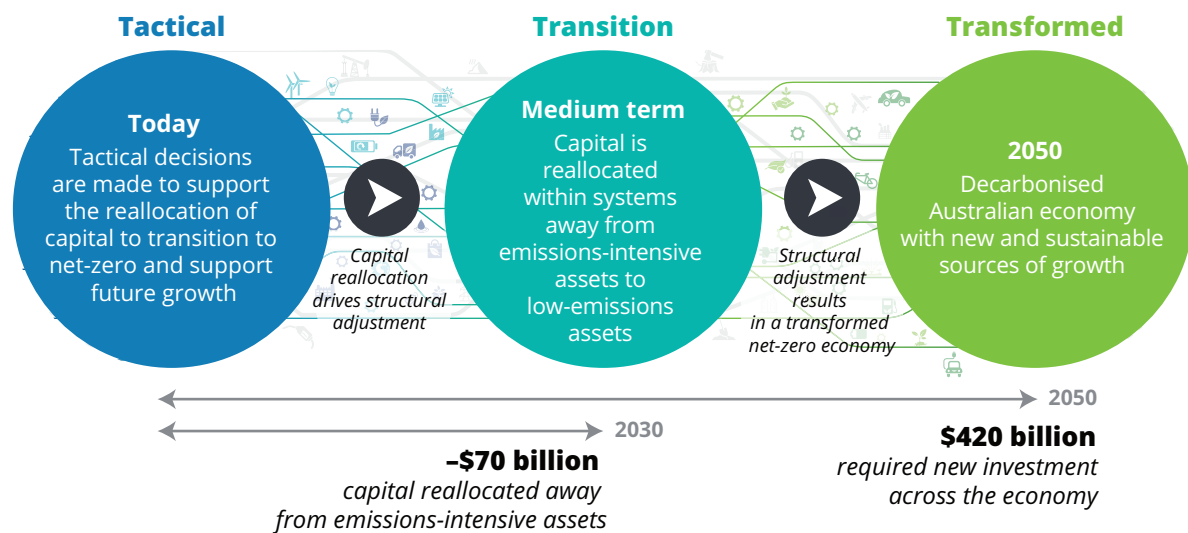
Deloitte Access Economics estimates that at least **\$420 billion in new investment is required** in Australia to achieve a productive and competitive net-zero economy by 2050 (compared to an economy that is not net-zero).ⁱⁱⁱ

This new investment is specific to the structural changes that will make our economy net-zero. For example, the formation of new industries such as hydrogen and the reengineering of Australia's energy and transport systems. This new wave of investment is above and beyond what Australian government, business and industry would otherwise be investing as the economy grows over the decades to 2050.

Alongside this new investment is a significant reallocation of capital – away from emissions-intensive activity and into the new low-emissions economic systems Australia needs to grow and create jobs.

This capital reallocation will peak in the medium term, when industries, regions and businesses begin to make bold transition plays and new markets open up. Over the next decade, around **\$70 billion of investment could flow out of emissions-intensive industries**, with the economic rate of return on further emissions-intensive investment significantly reducing in this period. A failure to effectively reallocate capital during this period increases the cost of Australia's transition to a low-emissions future economy in the long run.

Figure i: A new wave of investment



Source: Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.

ⁱⁱⁱ This is a net present value, assuming a real discount rate of 2%. The \$420 billion is relative to a baseline view of insufficient global and domestic mitigation action to mitigate climate change and a failure to reach net-zero by 2050.



Nothing happens in isolation

The scale and magnitude of this capital reallocation and new investment is unmatched to any structural adjustment the modern economy has seen. The Industrial Revolution took almost a century to change the world into an economy dominated by machines and industry. What will become Australia's 'Great Reallocation' of capital will occur in less than 30 years to change our modern systems of production and consumption to be low, or no, emissions. Just like the Industrial Revolution, if this transformation is done right, it will set Australia on a higher and more resilient economic trajectory.

Given the scale of change required, Australia's transformation is best thought about by the systems that must change – an electrified vehicle fleet significantly addresses climate change only if it is charged with clean, renewable electricity and the cars are manufactured with circular, low-waste processes using sustainable raw materials. Different elements of the economy must change at the right time and at the right scale to realise the net-zero ambition. Nothing happens in isolation.

As business, government and community leaders increasingly confront climate change through commitments and targets, sufficient capital will not be mobilised through isolated transactions or fragmented responses.

A systems approach recognises the interdependencies of actions and can be used to create economic cooperation. Some of the most powerful and impactful climate solutions lie at the intersection of emerging low-emissions systems in Australia and the investment required across them.

Systems geared for low-emissions growth

Over the next 30 years, Australia is expected to invest around \$20 trillion of capital in the economy (net present value). This is the total level of expected investment in a net-zero economy by 2050, including investment directly related to the transition (i.e. including investment in renewables) and investment not directly related (i.e. education and health investment).

Of the total expected investment in a net-zero Australia, around **\$4 trillion is estimated to reflect the capital flows and investments across four identified economic systems that are being reset** to form a series of complex, interconnected and emissions-free systems. These are the energy, mobility, raw materials manufacturing and food and land use systems.

These systems act as the foundation of Australia's emerging economic opportunities in a net-zero world. From today to 2050, Australia's industry, business, and governments will reallocate investments across these systems, towards emerging low-emissions opportunities.

Deloitte Access Economics estimates that of the estimated \$420 billion in new capital investment required to achieve Australia's emissions target, around **\$400 billion^{iv} will be required across the four core economic systems and enabling areas** that must become low emissions. This investment and these changes will take place in every business and in every household. Australia's transition is a whole-of-economy transformation.

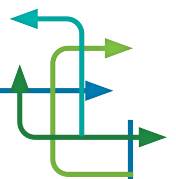
Capital reallocation in the economy

The capital reallocation and new investment figures reflect a 'net' view of investment overtime at both the economy and system level. The 'net' view accounts for capital that moves out of high emissions industry, processes, and assets, and into lower emissions economic activity. It also accounts for new investment, above and beyond, what may otherwise occur as the economy decarbonises.

For example, over the next decade around \$70 billion must be reallocated in the economy, or move out of emissions-intensive activity and into low emissions activity. While to 2050, \$420 billion in new investment could flow into low emissions activity as Australia becomes net-zero.

The \$420 billion in new capital investment out to 2050 accounts for the capital reallocation during the transition of the economy as it moves to lower emissions activity. This shows that over the period, net investment is growing and is above what would otherwise occur due to the economy becoming net-zero.

It is also important to note that the additional level of capital investment required also accounts for the continued physical impacts of a changing climate on the economy. Disruption to capital investment or unproductive investments on repairing assets, for example, as opposed to productive investment growth is accounted for in these figures.



^{iv} This is a net present value, assuming a real discount rate of 2%. The \$400 billion is relative to the same baseline view.

NEW investment that delivers the net-zero transformation

By 2050...

\$420 bn


Total new investment across Australia's economy

of which

\$400 bn


is invested in economic systems that must become low emissions


\$100 bn
Energy


\$30 bn
Mobility


\$50 bn
Raw materials manufacturing


\$20 bn
Food and land use

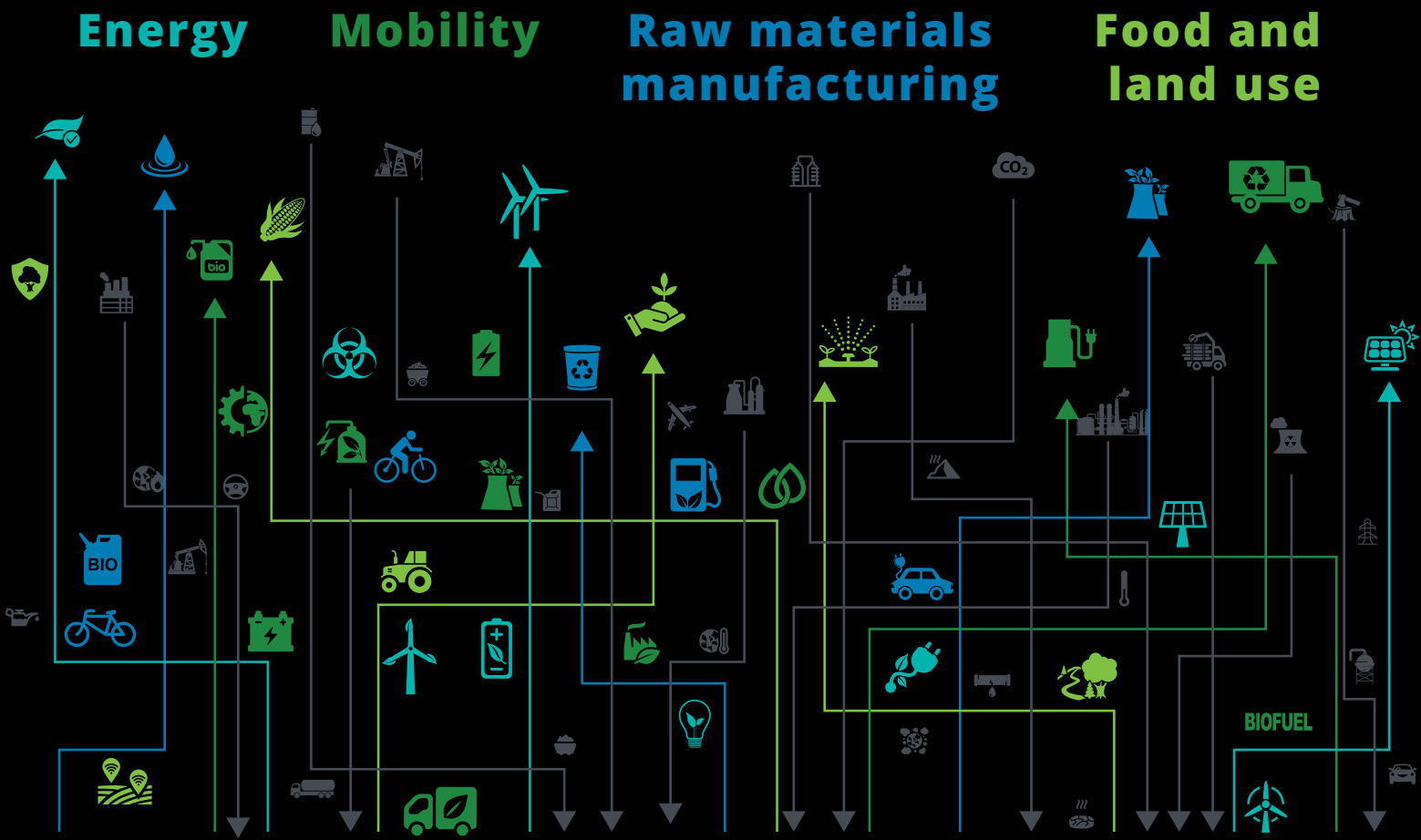

\$200 bn
Enabling services

Australia's 'Great Reallocation' of capital shifts investment to achieve net-zero

By 2050...

\$4 trillion

Total investment in core economic systems that become low emissions



Investment reallocation across core systems

The speed and scale of this system transformation comes down to the levers of change being pulled at the right time, in the right way. The financial system and capital investment, government policy, technological innovation, consumer choice, and business strategy all have unique, but connected, roles in catalysing the emergence of low-emissions systems as the Australian economy decarbonises.

A transformed energy system... \$100bn of new capital needed in the next 30 years

Take energy as the economic system that supports all modern activity and daily life, and the system which produces the most emissions in Australia. Over the next decade, Deloitte Access Economics estimates around \$25 billion (net present value) must be reallocated away from emissions-intensive to low-emissions assets in the energy system. When it comes to new investments, around \$100 billion in additional capital must flow into low-emissions assets for the Australian economy to be on the path to net-zero.

A transformed mobility system... \$30bn of new capital needed in the next 30 years

Mobility in Australia's economy is not just about who and what goes where, and the mode in which it gets there. The mobility of Australia's people and goods is a driver of economic growth and productivity, and the emissions that come with this. Over the next decade, Deloitte Access Economics estimates around \$3.5 billion (net present value) must be transferred to low-emissions transport and infrastructure assets and their associated activity in the mobility system.

On this net-zero trajectory, around \$30 billion in additional capital must flow into low-emissions mobility assets.

A transformed materials manufacturing system... \$50bn of new capital needed in the next 30 years

What Australia makes and how it is made has always shaped Australia's economic history. Into the future, changing customer demand, different raw materials and new ways of manufacturing will combine with the need for low emissions to remake the manufacturing system. Over the next decade, Deloitte Access Economics estimates around \$1.5 billion (net present value) will be reallocated to low-emissions assets and their associated activity in the manufacturing system. New investment in the order of \$50 billion must flow into low-emissions manufacturing assets on this net-zero trajectory.

A transformed food and land use system... \$20bn of new capital needed in the next 30 years

Food and land use is a critical system not only for growth, but general well-being. It provides the basis for nutrition and shelter, but its value comes at an emissions premium. Over the next decade, Deloitte Access Economics estimates around \$0.1 billion (net present value) must be reallocated to low-emissions assets and activity in the food and land use system. Around \$20 billion in additional capital must flow into low-emissions food and land use assets to meet Australia's net-zero target.

Services are a core input across the transformation of all four systems. To fuel the transformation of the four systems, \$200 billion of new capital is needed across financial, insurance, business, real estate, communication and recreational and other services, out to 2050.



The **energy system** is critical to how everything in the economy functions. The system's core industries relate to energy generation, but the system also includes upstream industries such as resource exploration and extraction, related manufacturing (e.g. solar panels) and construction (e.g. new generation assets) and downstream industries such as electricity distribution.



The **mobility system** encompasses all transport functions and the inputs required (i.e. fuels, car manufacturing). The transformation of the mobility system will require the near-complete replacement of the vehicle fleet with the systems approach factoring in the emissions of inputs and processes required to achieve this.



The **materials manufacturing system** provides vital inputs to all aspects of the economy. The system includes hard-to-abate operations, which currently have few viable low-carbon alternatives. Cement, steel, aluminium, and other hard-to-abate heavy industries could see much wider use of green hydrogen and electrification, with on-site carbon-capture technology playing an important role.

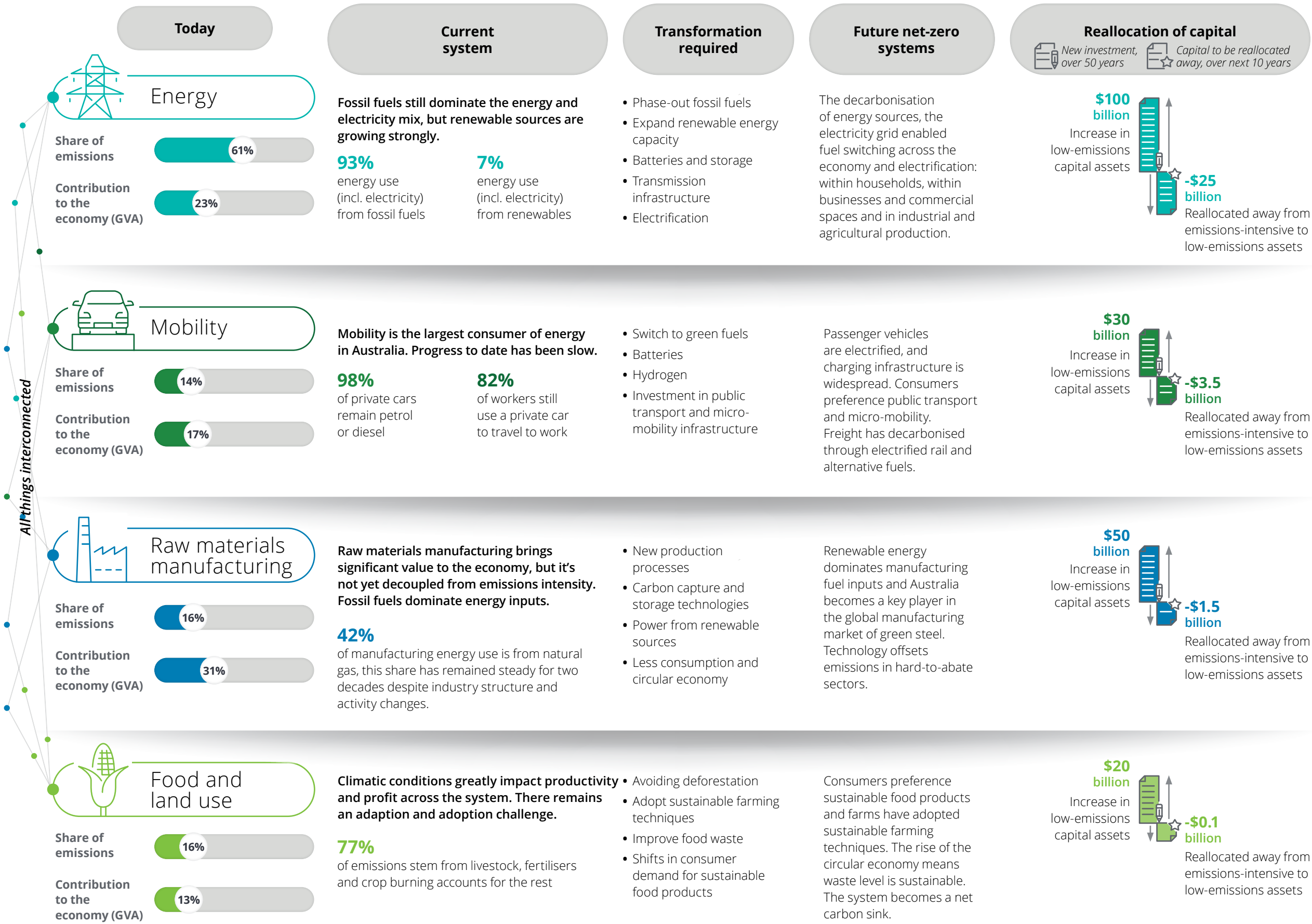


The **food and land use system** feeds the world. The system contributes significantly to emissions through livestock husbandry, crop burning, and deforestation. The transformation of the food and land use system is expected to see the system go from being a significant contributor to emissions to a net carbon sink.

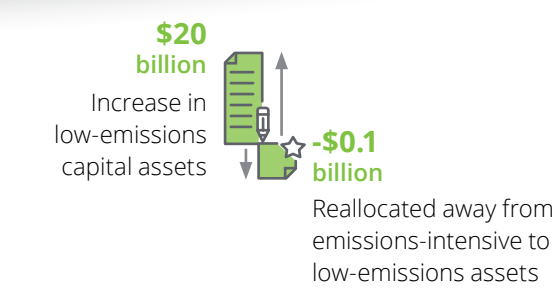
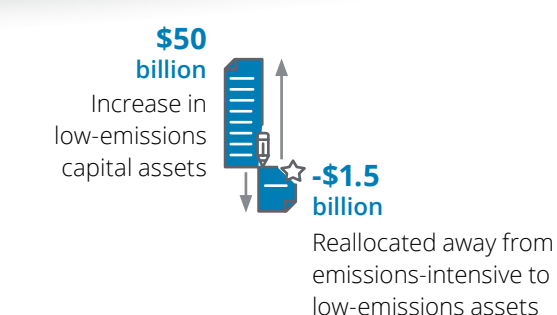
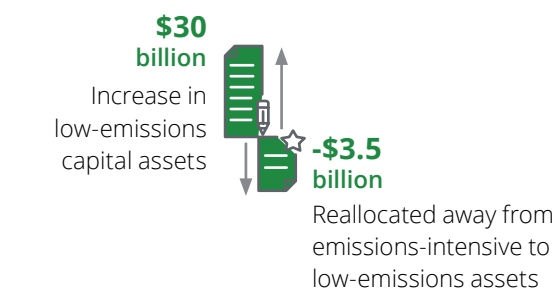
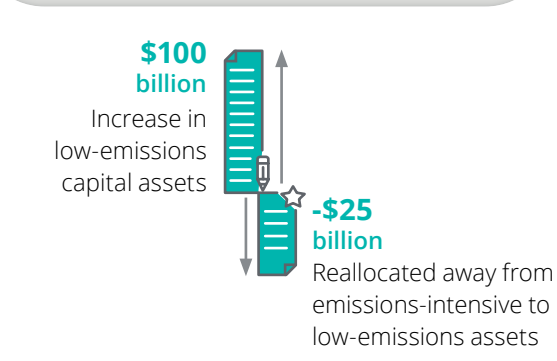


Enabling services

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Reallocation of capital



Economic gain of net-zero transformation

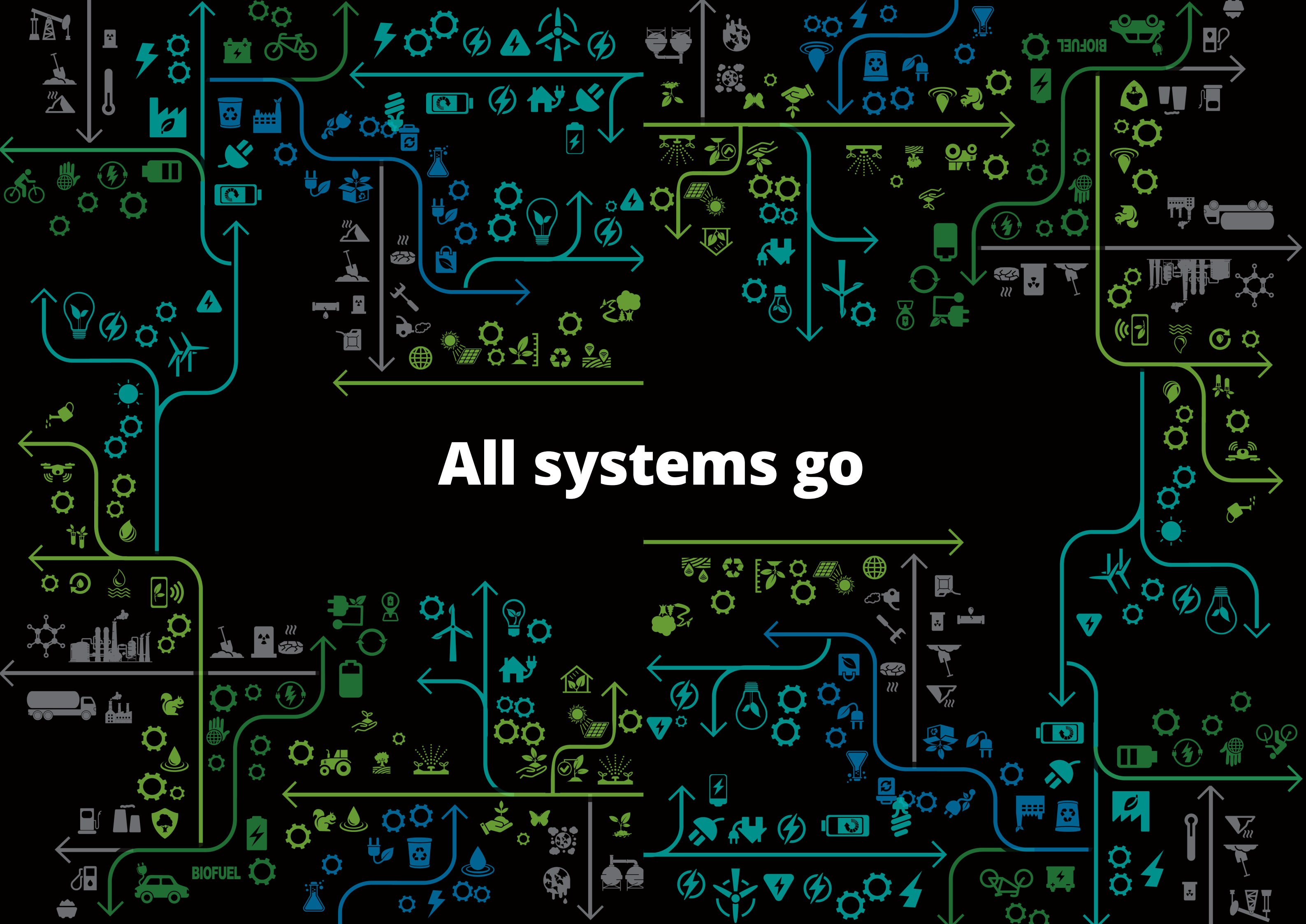


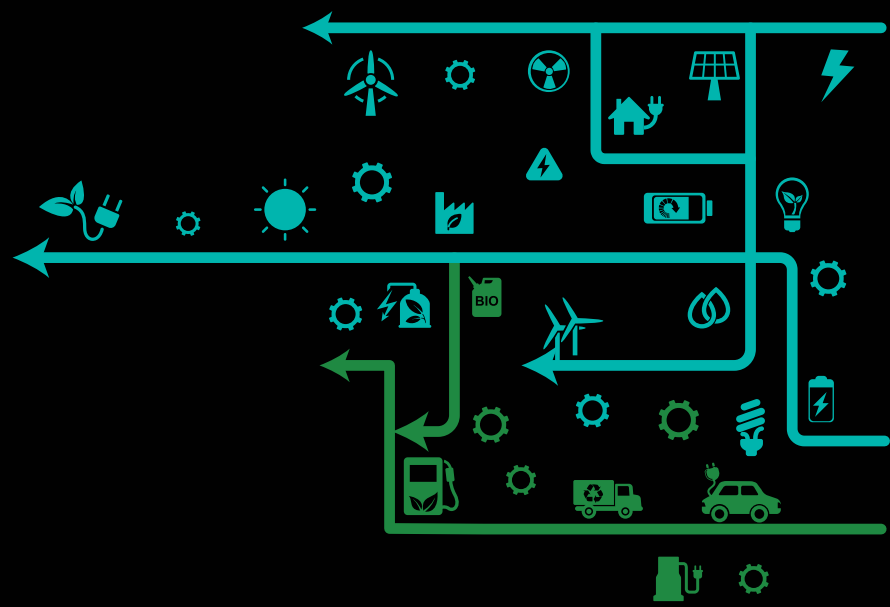
As close to **1.5°C** of global average warming



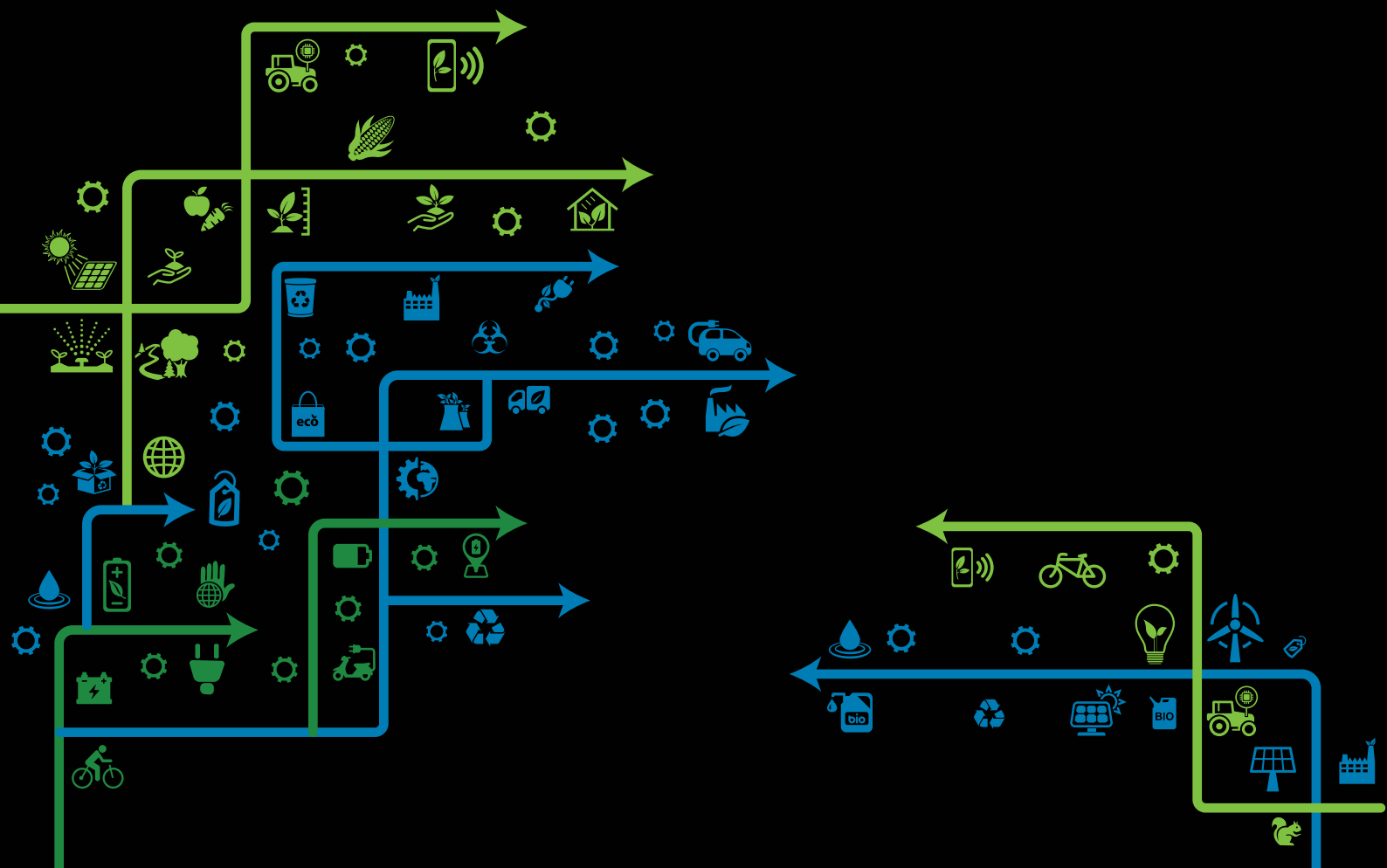
Note: percentages do not add up to 100, due to overlap of system elements.

All systems go





Transformation is the
business of the decade



The structural adjustment and value creation that will occur in response to climate change will be **the business of this decade**. As businesses, government and regulatory bodies increasingly commit to net-zero targets and announce climate initiatives, the direction and scale of change is inevitable. This inevitability brings a clear focus on the need for, and the scale of, the task of this transformation. This 'Great Reallocation' of capital will dominate the commercial, regulatory and policy landscape in Australia, and globally, over the coming decade.

The pace and scale of transformation is critical

The execution of net-zero targets is not easy, but the deadline of meeting them is firm. The number of internal net-zero commitments adopted by ASX200 companies tripled in the year up to October 2021^v, but despite increasing commitments, many businesses and organisations are yet to release detailed plans of how commitments will be met.

To meet current pledged targets, and to limit climate warming to well below 2°C requires significant pace and scale. The scale of change required to meet net-zero is nothing short of an industrial revolution – one which needs to occur at a speed that is unparalleled to any other economic transformation in history.

This force of change is being felt among governments, business, regulatory institutions and households, as consideration of the short-term risks of uncoordinated climate action and longer-term risks of insufficient or delayed action underpin decision making. Like how cyber risks are now a key consideration for businesses, the risks of climate change are now being factored into decisions about capital allocation, development of products or services, and supply chain management decisions. However, this is yet to be achieved at the scale required to successfully decarbonise and fuel strong economic growth.

While a transition of this magnitude comes with a variety of complex challenges, it is likely that **an uncoordinated transition will prove more expensive and disruptive compared to one which is coordinated and orderly**. Deloitte Access Economics' modelling for the Business Council of Australia showed that there is a net present value cost to Australia's economy of \$390 billion in GDP by 2070, if Australia fails to rapidly coordinate the actions that deliver net-zero emissions by 2050.²

To avoid these significant costs and lost opportunity, rapid and coordinated investment is needed today.

Australia's net-zero capital transformation

Australia's economy has entered a period of transformation, however, action on climate change still lacks transparency and coordination, which creates market uncertainty. The latest IPCC report was a reminder of the level of global effort required to limit global warming. The report emphasised that the optimal environmental and economic benefits of the transformation will come down to the levers of change being pulled at the right time, with the right scale.

The **financial system has the mechanisms in place to influence investment decisions** across the board – providing much needed capital flow coordination at the whole-of-economy level. Over the next 30 years, **Australia's public and private sectors need to invest around \$20 trillion in the economy across the board**.^v How this is spent, matters for Australians' standards of living, employment and well-being.^{vi}

In the short term, global decarbonisation will accelerate and tactical policy, capital reallocation and technology will need to be deployed in Australia to support the transformation of supply chains, business operations, innovation and price signals. Creating the right foundation today will reduce uncertainty and optimise future transformation benefits. By 2030, **Australia will need to triple the level of new capital investment annually** (compared to today) to be on the path for a modern, productive, and net-zero economy.

The most significant disruption will occur in the medium term, when industries, regions and businesses start to make bold **transition** plays and create new markets. The hardest transitions in industrial policy, energy systems and consumer behaviour will occur in the next decade. By 2030, nearly -\$70 billion needs to flow out of emissions-intensive industries, with the rate of return on any further emissions-intensive investment significantly reducing in this period.^{vii} Without financial markets contributing to this reallocation, there is a higher risk of stranded assets, worker dislocations, and increased transition costs, due to delayed action.

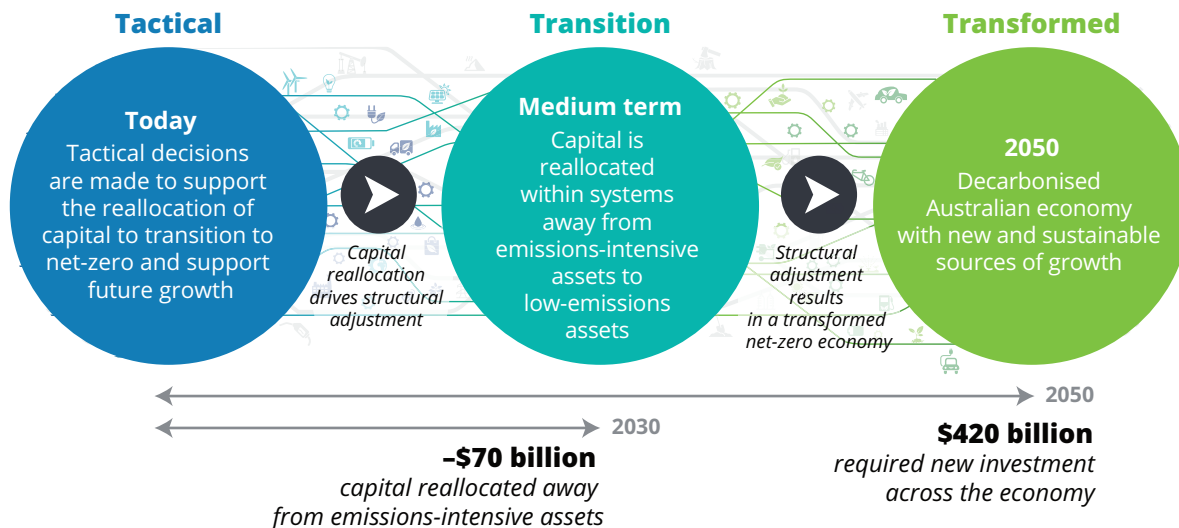
In the following years out to 2050, high-emitting sectors will become decarbonised and **transformed**. By 2050, Australia's economic structures would be radically transformed, underpinned by a series of interconnected, low-emissions systems spanning energy, mobility, manufacturing and food and land use.

^v This is a net present value, assuming a real discount rate of 2%. Analysis from Deloitte Access Economics.

^{vi} Refer to the Technical Appendix, for detail on how the numbers were derived.

^{vii} Ibid. In deviation terms (scenario deviation from baseline), the level of investment is -\$78 billion between 2021 and 2028, signalling a transition away from carbon-intensive investment, which has a low rate of return on investment under a net-zero scenario.

Figure 2: Economic transformation to achieve net-zero by 2050



Source: Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.

Reallocation at the sector level

As the forces of change ripple through financial markets, the return on investment from fossil fuels and emissions-intensive electricity generation is expected to decline, with new and reallocated capital being directed towards renewables and other industries that support the net-zero transformation (such as construction). This annual distribution among sectors is shown in Chart 1 and reflects the net level of investment flows in the Australian economy. The dip in investment in the initial transition years reflects the public sector, industries and investors all avoiding emissions-intensive investment, which otherwise would have been made if Australia and the world didn't actively take steps to mitigate climate change. New investment is being allocated across emerging and growing industries, and the economic returns on the initial transition investments become positive and grow larger with each year as the economy gets closer to net-zero by 2050.

The economic dividend of getting the capital reallocation right (as depicted in Chart 1), is a gain of \$890 billion^{viii} to Australia's economy by 2070.

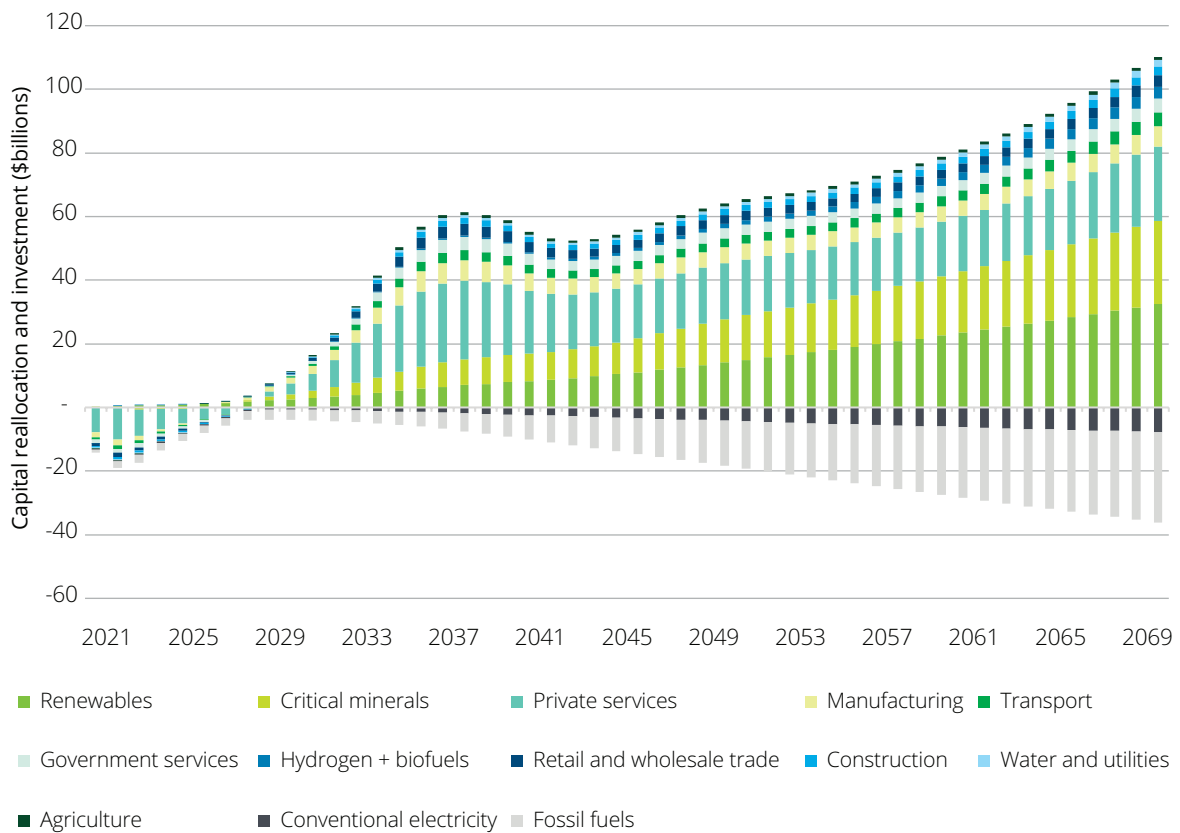
This economic outcome is underscored by this investment, coordinated government policy, incentives, and regulation – out of the industries of a high-emitting world and into the new technologies and industries that create growth and jobs in a net-zero future.

Critically, the transition requires the availability of financing for research, and development, new financing and operational models, compensating for stranded assets, accounting for loss of value pools across the economy and reskilling and redeploying workers.

Significant and ongoing flows of new capital investment is needed to ensure innovative decarbonisation technologies and climate solutions continue to be developed and come to market before there is any certainty about viability or scalability. Sufficient capital will not be mobilised through isolated transactions.

^{viii} This is a net present value, assuming a real discount rate of 2%. Analysis from Deloitte Access Economics for the Business Council of Australia.

Chart 1: Annual capital reallocation and investment flow to meet net-zero



Source: Deloitte Access Economics (2021)

As business, government and community leaders increasingly act on climate change through commitments, targets and their own corporate governance, they face critical bottlenecks and fragmented approaches. Uncertainty on all fronts – consumer preferences, time horizons, regulation, and government support – is causing an imbalance of supply and demand. For example, many consumers express a desire for electric vehicles, but resist purchases as charging stations are not widely available, while charging providers are hesitant to deploy widespread infrastructure without clearer evidence that consumers will use it.

To overcome the risks and challenges that come with uncertainty requires coordination and a **systems view of the economy – one that unlocks critical opportunities in the transition to a low-emissions economy** by working at the intersection of emerging low-emissions initiatives.

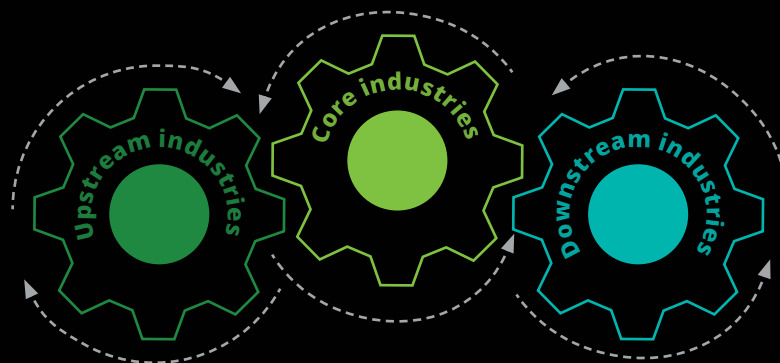


What are systems?

Systems are collections of interconnected elements that deliver on a common purpose. Unlike industries and markets, systems are not grouped by **activity**, nor do they have universally defined boundaries and standard compositions. Instead, systems are unified by their common **purpose**. Given that most end goals are the product of several different kinds of economic activity, systems are broader and more expansive than industries.

The structure of a system is determined by how its elements combine to deliver on their purpose – be that a market, end user or problem. A system’s **upstream industries** provide the necessary materials and foundations for a product to exist in its market form. Core industries, meanwhile, transform these foundations into goods and services. **Downstream industries** broker transactions between the core industries and purchasers. In the manufacturing system, for example, upstream industries extract raw materials and provide the energy used in processing. Core industries (like cement, cotton, and steel) transform these inputs into products, before downstream industries like retail bring them to the public.

Similarly, many systems share common elements – like industries and supply chains – that serve multiple purposes within the economy. **These overlaps create the interdependencies that reinforce the need for a systems approach.** The scale and timing of an industry’s contribution varies by system. For example, a wide range of core industries for the energy system (like fossil fuels and hydroelectricity) provide the upstream energy used in manufacturing. It follows, then, that decarbonising the energy system will significantly aid decarbonisation in the manufacturing system. These interdependencies elude industry-level analysis, further underwriting the need for a systems lens that improves our understanding of interconnections within the economy.



A new way of thinking: a system lens

To achieve the coordinated scale necessary for an efficient and inclusive transition, all firms that interact with one another within an economy, need to be moving towards the same goal. Fragmented action is unsuited to a challenge like climate change, where concerted, coordinated efforts are needed to effectively address the issue. What's needed is a more holistic systems approach, so interdependencies of actions can be observed and used to create synergies absent from isolated responses.ⁱⁱⁱ **Some of the most powerful and impactful climate solutions lie at the intersection of emerging low-emissions systems.**

A lack of systems thinking creates bottlenecks and fragmentation for an array of these solutions. For instance, an electrified vehicle fleet significantly addresses climate change only if it is charged with clean, renewable electricity and the cars are manufactured with circular, low-waste processes using sustainably extracted raw materials. Capitalising on systemic synergies to achieve transformation at the lowest possible cost, will only **strengthen Australia's economic potential through the economic transformation.**

The shift towards a systems lens is not new. What are considered to be traditional industries are continually blurring and giving way to new business systems with new business ecosystems. As climate change increasingly becomes the business of the decade, these shifts are accelerating. Interconnected systems made up of existing and new industries are now being reset through the rapid adoption of new technologies, shifts in operating processes, and the transformation of business models.⁴ New and old industries are coming together to form a series of complex, interconnected and emissions-free systems – energy, mobility, raw materials manufacturing and food and land use systems.

The financial system and capital investment, government policy, technological innovation, consumer choice, and business strategy all have unique, but connected, roles in catalysing the emergence of low-emissions systems as the Australian economy decarbonises. These 'transformation levers' will drive Australia to net-zero emissions, enabling systems with the opportunity, capacity and incentives to decarbonise.

The following sections step through how each system is considered within this analysis, and what are the core industries driving economic activity and transformation. See Appendix A for a theoretical breakdown of what makes up a system.

Enabling services for the transformation



Service sectors and the workers within them are a core input across the transformation of all four systems. How these services interact with each system and the evolution of Australia's service sector will transform the future of work and skills, the growth trajectory of the economy and productivity.

To enable the transformation of the four core systems, \$200 billion of new capital investment is needed across government, financial, insurance, business, real estate, communication and recreational and other services (for example) over the next 30 years.

Energy system

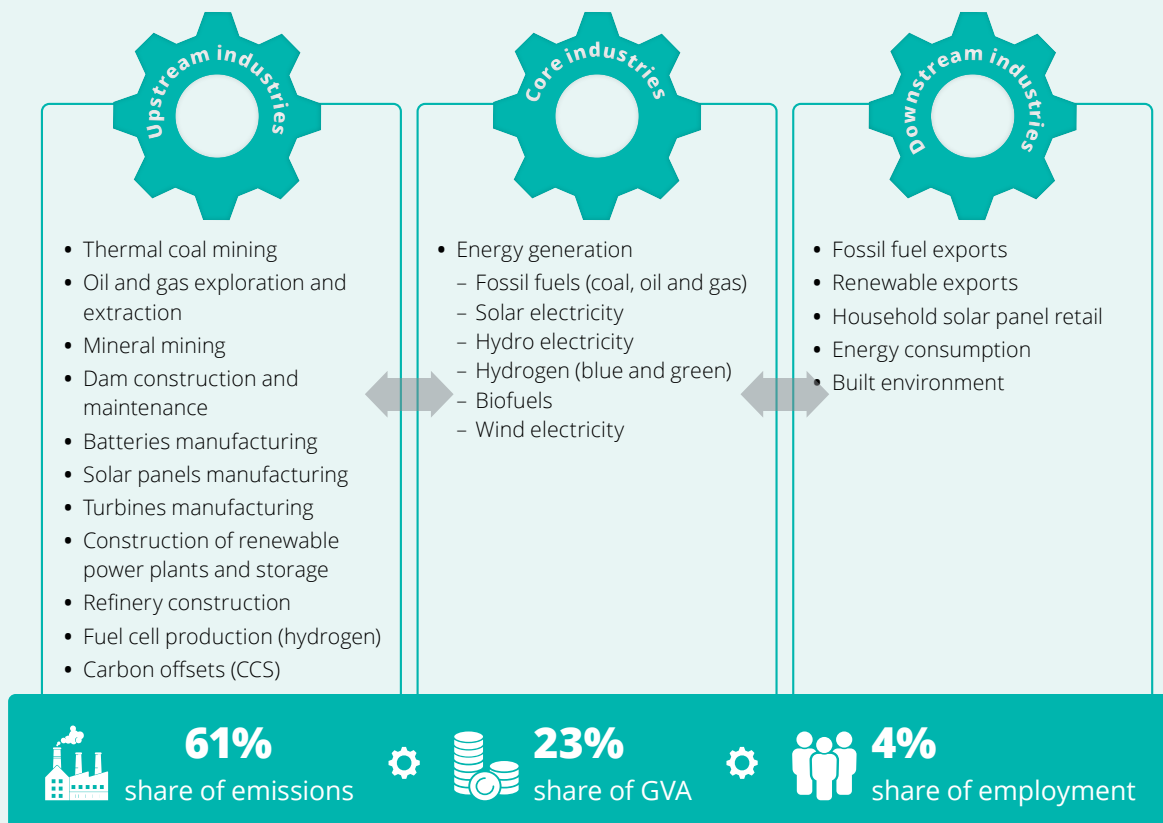


The **energy system** is critical to how everything in the economy functions. The system's core industries relate to energy generation, but the system also includes upstream industries such as resource exploration and extraction, related manufacturing (e.g. solar panels) and construction (e.g. dams). The systems approach is an important perspective to ensure investments (e.g. technology R&D) are supported by the necessary inputs to make these investments successful and sustainable over the long term (e.g. minerals and rare earths).

Economic growth and energy demand have long been intrinsically linked. As economies grow, demand for energy increases; if energy is constrained, GDP growth pulls back in turn. But as we see the decoupling between rates of economic growth and energy demand, this doesn't mean that energy demand is falling, only that the nature of the composition of energy demanded is shifting, and no longer fully reliant on emissions-intensive fuels.

For the purposes of this analysis, the core industries of the system are those which drive energy generation; fossil fuels and a mix of renewable energy sources (Figure 3). Energy generation is defined as the amount of energy generated in the Australian economy, including from fossil fuels, hydro power plants, solar panels, geothermal systems, biofuels and wind. The downstream industries capture economic activity which consumes energy, such as businesses, industrial production and households. The upstream industries are those which provide the economic inputs into the core industries, such as the mining of minerals or the manufacture of solar panels.

Figure 3: Australia's current energy system



Source: Deloitte Access Economics; System mapping workshop with NAB.

Note: Energy consumption and build environment was not captured as part of the ANZSIC mapping process

New mobility system

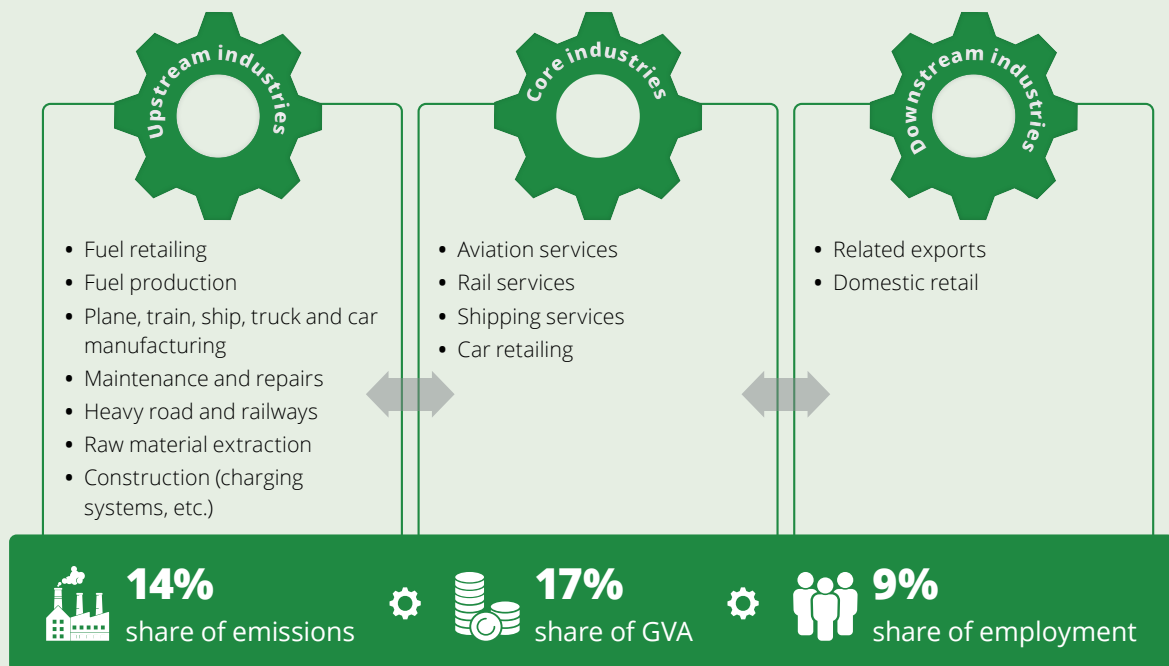


The **mobility system** encompasses all transport functions and the inputs required (i.e. fuels, car manufacturing). The transformation of the mobility system will require the near-complete replacement of the vehicle fleet, the systems approach factors in the emissions of inputs and processes required to achieve this – an electrified vehicle fleet significantly addresses climate change only if it is charged with clean, renewable electricity and manufactured with circular, low-waste processes using sustainably extracted raw materials.

Mobility in Australia's economy is not just about who and what goes where, and the mode in which it gets there. The mobility of Australia's people and goods is a driver of economic growth and productivity, and the emissions that come with this. These emissions will only fall if behaviours shift away from emissions-intensive transportation and low-emissions transportation develops and scales.

The core industries considered in this analysis within the mobility system are those that move people and goods from one destination to another – road transport, rail transport, shipping and aviation. Upstream industries are those that enable this function. They include vehicle manufacturing, primary inputs like fuel or electricity and transportation infrastructure like railways and roads. Downstream industries are those that leverage core industries to sell their products. For example, agriculture exports rely on shipping services to move their products from suppliers to customers.

Figure 4: Australia's current mobility system



Source: Deloitte Access Economics; System mapping workshop with NAB.

Materials manufacturing system

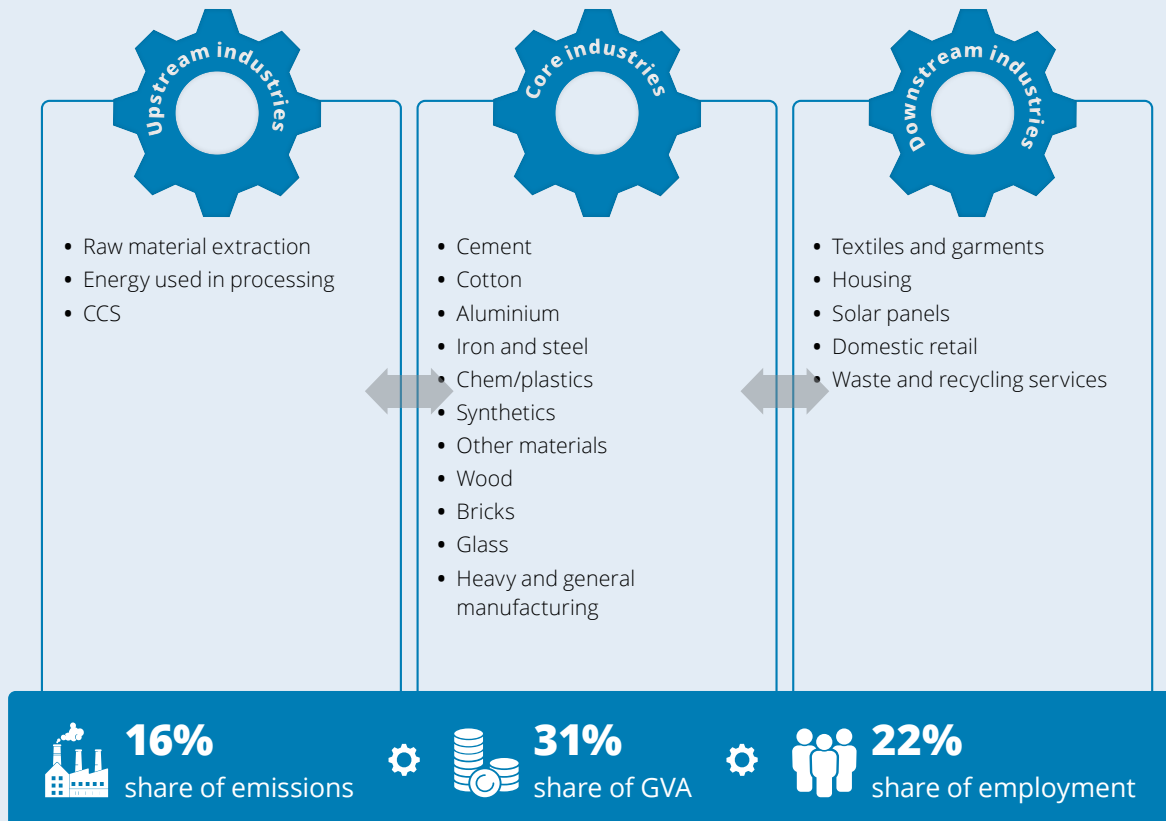


The **materials manufacturing system** provides vital inputs to all aspects of the economy. The system includes hard-to-abate operations which currently have few viable low-carbon alternatives. The transformation of this system will likely see changes in every sector and along nearly every step of the value chain. Cement, steel, aluminium, and other hard-to-abate heavy industries could see much wider use of green hydrogen and electrification, with on-site carbon-capture technology playing an important role.

Australia is one of the most resource-rich countries in the world and plays a leading role as a materials supplier on the world market. Into the future, what Australia does with the materials will matter as changing customer demand, different raw materials and new ways of manufacturing will combine with the need for low emissions to remake the manufacturing system.

In this analysis, the core industries in the materials manufacturing system are the processed resources that provide inputs for end-market goods, like cement in houses and cotton in clothing. Upstream industries help produce these inputs – for example, the extraction and processing components of production, as well as the carbon capture and storage that removes the hard-to-abate emissions of these industries. Downstream industries transform the refined raw materials into consumer products like solar panels, appliances and homes.

Figure 5: Australia's current materials manufacturing system



Source: Deloitte Access Economics; System mapping workshop with NAB.

Food and land use system

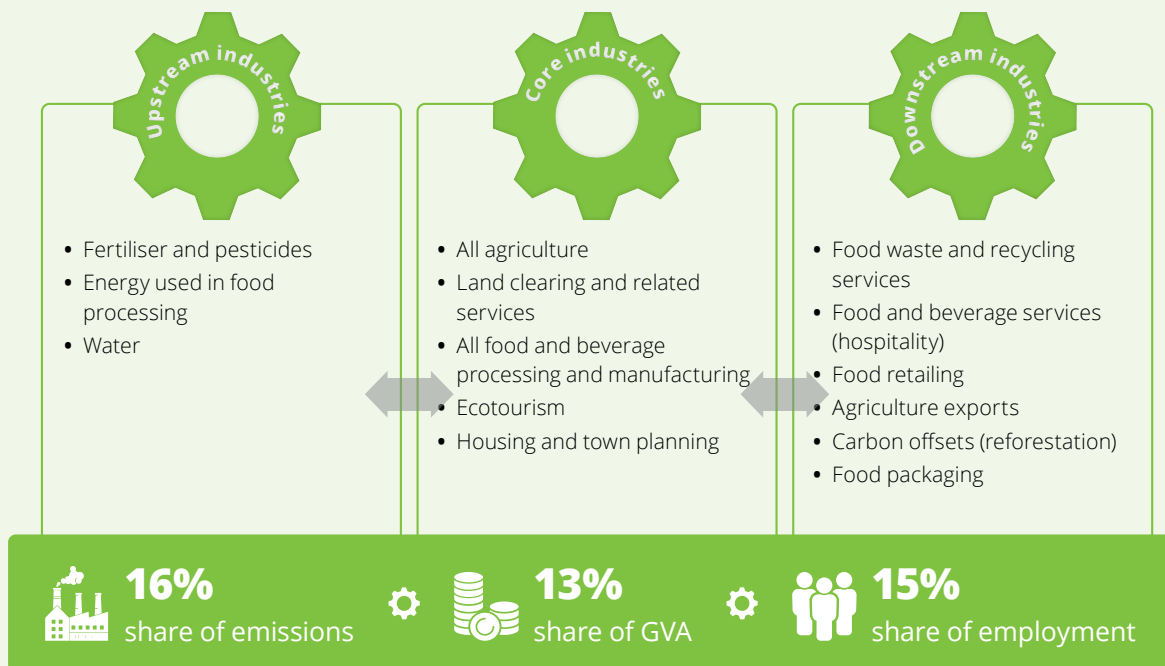


The **Food and land use system** feeds the world. The system contributes significantly to emissions through livestock husbandry, crop burning, and deforestation. The transformation of the food and land use system is expected to see the system go from being one of the largest sources of emissions to a net carbon sink. Successful transformation requires the widespread implementation of farming techniques designed to capture and sequester carbon in soil, effective land use (e.g. agroforestry) and regenerative practices.

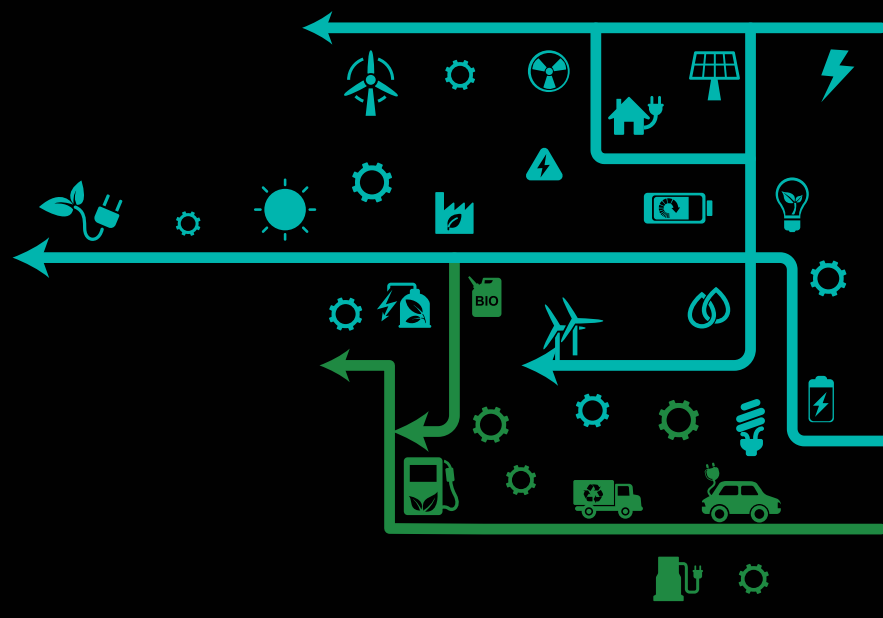
Population growth – and, by extension, economic growth – inevitably creates more demand for food and land. These are both essential for human well-being, but some current practices in the food and land use system are incompatible with a net-zero economy. As the world economy transitions, decisions around food and land allocations will come to incorporate the environmental impact of each choice, so that this system more holistically supports human well-being.

The core industries within this system add value to food and land. Agriculture, food and beverage manufacturing and town planning all transform food and land into products. Upstream industries facilitate these transformations. For example, agriculture is not possible without fertiliser and water, and food cannot be processed without energy. Downstream industries take food and land use to consumer markets. Food retailers and hospitality services are an interface between agriculture and consumers, and the carbon offset industry absorbs consumer demand for environmentally friendly land use.

Figure 6: Australia's current food and land use



Source: Deloitte Access Economics; System mapping workshop with NAB.



All systems go

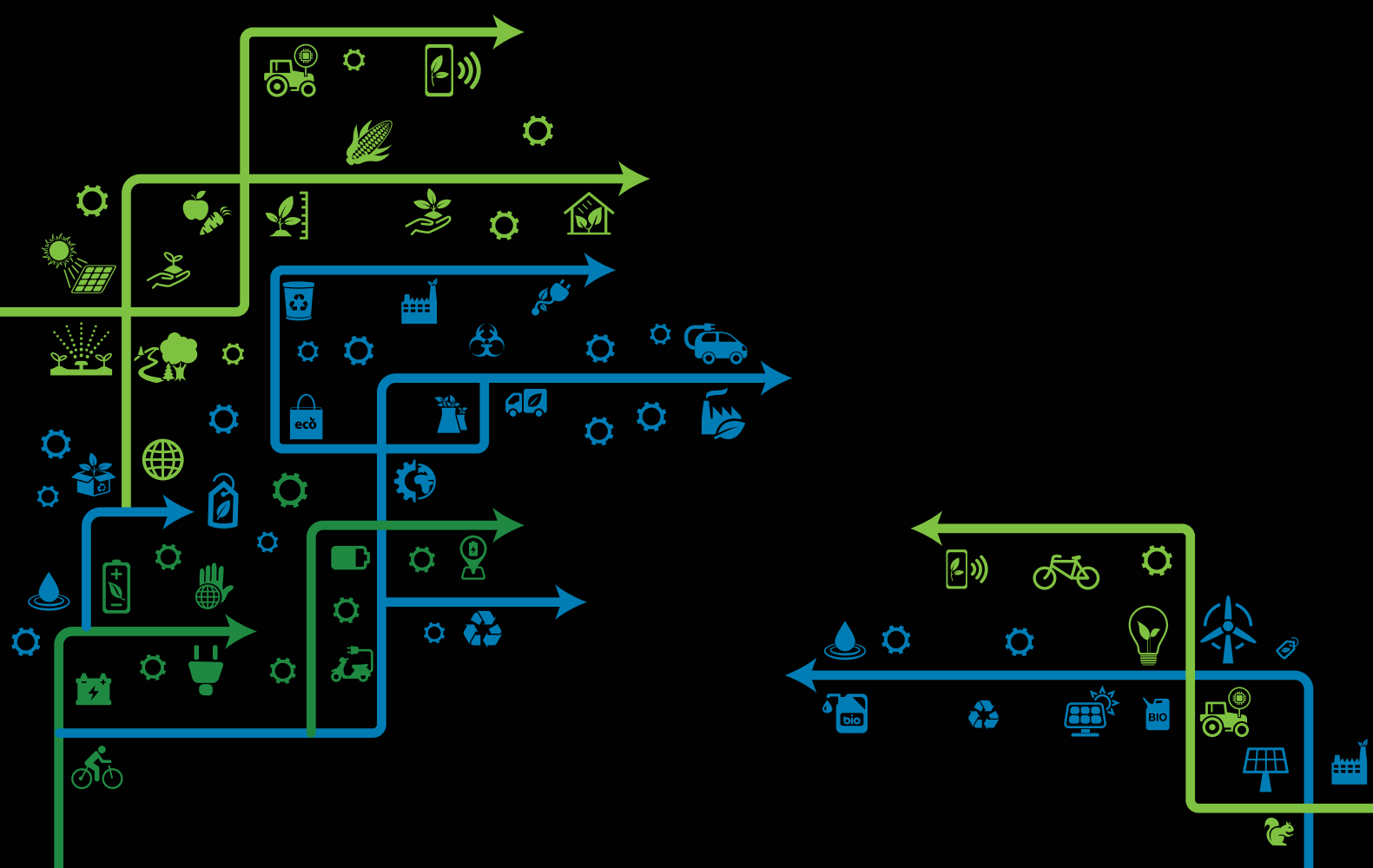
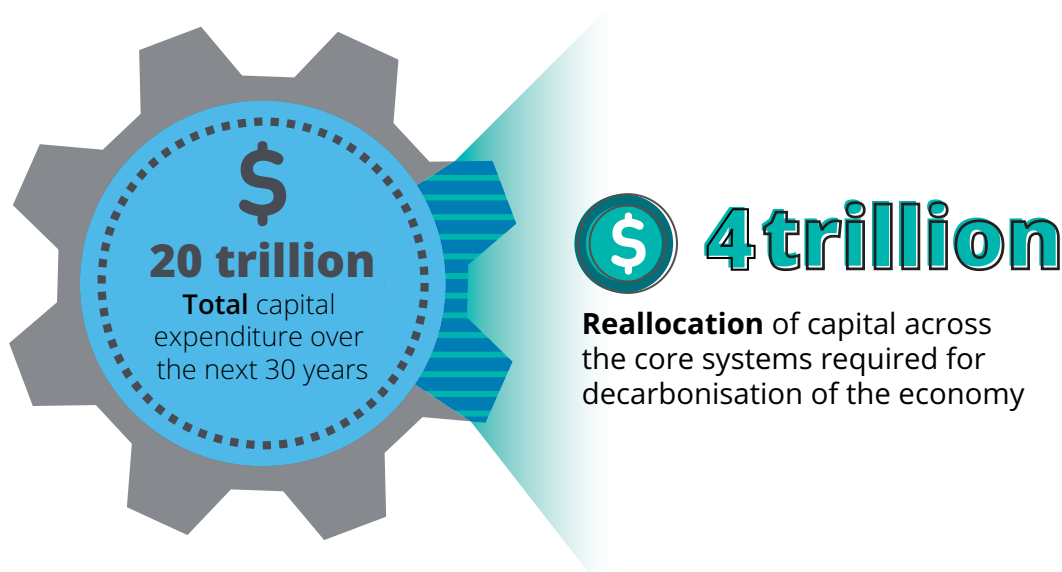


Chart 2: The net-zero capital transformation



Source: Deloitte Access Economics. Note: Net present value, 2021-2050.

New economic systems in a net-zero world

Australia's transformation to net-zero is best thought about by the systems that must change. Different elements of the economy must change at the right time and at the right scale to realise the net-zero ambition. It is energy, mobility, raw materials manufacturing and food and land use systems that will act as the foundation of Australia's emerging economic system for a net-zero world.

Of the total \$20 trillion (net present value) expected to be invested across Australia's public and private sectors, around \$4 trillion is estimated to reflect capital flows and investments across these four core economic systems that must become low emissions. Of the estimated \$420 billion^{ix} in total new capital investment which needs to be mobilised in Australia, around \$400 billion is required across the four core economic systems and enabling areas that must become low emissions.

A new energy system

The energy system supports all modern activity and daily life. It is foundational to Australia's past, current and future economic growth, but it is also the system which produces the most emissions in Australia. Fossil fuels still dominate the energy and electricity mix, with 93% of energy use and 75% of electricity generation still fuelled by burning fossil fuels.⁵ While renewable sources are growing strongly, with renewable electricity generation more than doubling over the past decade, the pace and scale must accelerate.

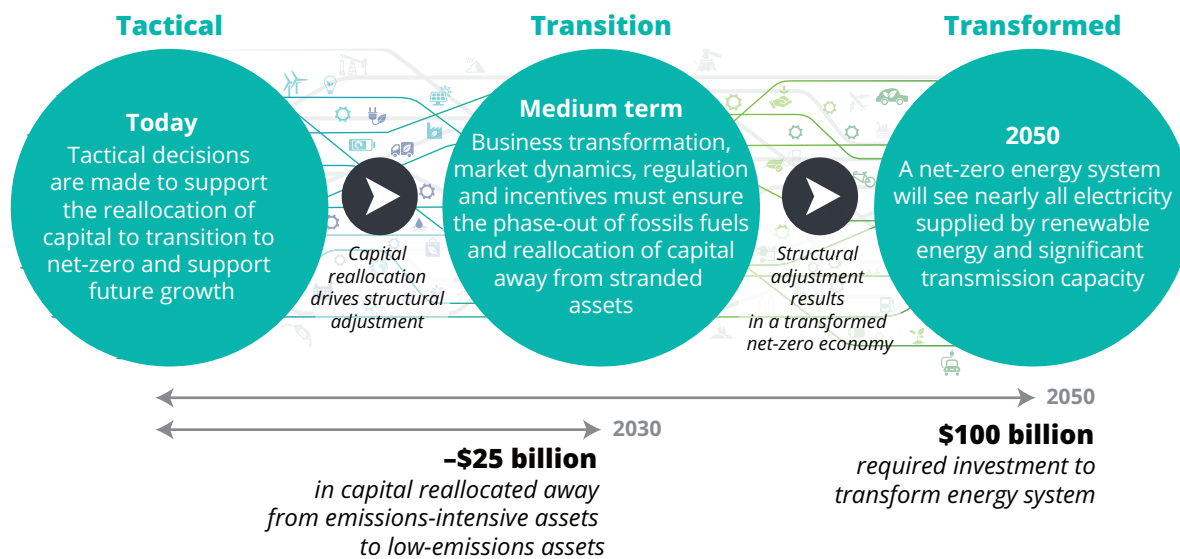
With the energy system critical to all economic activity, with interdependencies far-reaching across all sectors, market forces will be strong, but a coordinated and concerted effort among players must be made to ensure sufficient capital is available.

- **Fossil fuel phase-out.** A net-zero Australia means huge declines in the use of coal, oil and gas. Current investment flows are making renewable energy more efficient, cheaper and stable, as fossil fuels will experience increasing price volatility and stranded assets in the long term, bringing little to no value to the economy. In de-emphasising fossil fuel usage in lieu of sustainable energy sources, market dynamics, regulation and incentives are needed to ensure strategic business transformation is timely to avoid the transition risks of defaulted loans, standard assets, bankrupted businesses and a stalled transition to net-zero.
- **Collaboration on an upgraded, sophisticated and expanded electricity grid and transmission infrastructure.** The transformation of the energy system will require a significant ramp up of capital spending on building transmission infrastructure to handle increased grid flows and upgrade to more sophisticated and integrated grid technologies.
- **Development of large-scale and longer-term storage capacity.** System flexibility provided by storage capacity is critical for the growing share of renewables, with the ability to absorb and manage fluctuations in demand and supply. Significant capital flows are required for both research and development and in manufacturing.

The complete transformation of the energy system is capital intensive, which means a significant amount of

^{ix} This is a net present value, assuming a real discount rate of 2%. Analysis from Deloitte Access Economics for the Business Council of Australia.

Figure 7: Capital reallocation required within the energy system



Source Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.

capital reallocation and new capital must be mobilised. Over the next decade, Deloitte Access Economics estimates around \$25 billion (net present value) must be reallocated away from emissions-intensive to low-emissions assets in the energy system. When it comes to new investments, around \$100 billion in additional capital must flow over the next 30 years into low-emission assets for the Australian economy to be on the path to net-zero.

A net-zero energy system will see nearly all electricity supplied by renewable energy, and significant transmission capacity and a more resilient and sophisticated grid-network will have supported the widespread electrification across other sectors, such as home heating and electric vehicles.

A new mobility system

Today the mobility system is Australia's largest consumer of energy, still heavily dependent on fossil fuels. Of the private cars on the road today, 98% remain fuelled by petrol or diesel and 82% of workers still use a private car as their mode of transport to commute to work.⁶ The transformation to low emissions across the mobility system has been slow to date, but change is starting to roll out.

To accelerate the decarbonisation of the mobility

system, a major shift in investment and business models is required, as well as regulation more conducive for new mobility modes of transport. To reach net-zero across the mobility system, each player has a role to play in the transition, necessitating collaboration between manufacturers (and importers), car retailers, government and transport authorities:

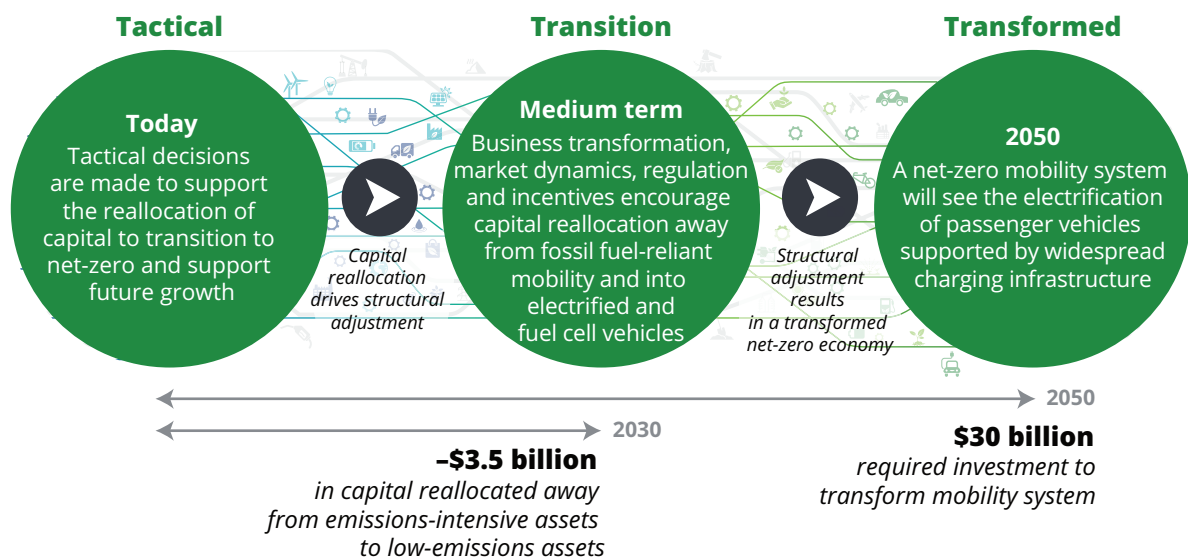
- **Consumers need to change their mobility behaviour.** Incentivisation will be required to significantly shift consumer attitudes and behaviour in making sustainable mobility their preferred and cost-effective choice. EVs need to improve in cost competitiveness and seamless integrated mobility technologies must be implemented to enable and accelerate adoption of multimodal travel without private cars.
- **Mobility providers and operators must foster innovation and sustainable multimodal travel services.** Ubiquitous charging infrastructure must be rolled out nation-wide, ensuring grid integration for load balancing, in collaboration with energy utilities, real estate owners, governments and businesses. Integrated mobility technologies must be developed and deployed to offer consumers alternative sustainable, efficient and cost-effective multimodal travel options, compared to private car travel.

- **Car manufacturers and retailers must reconfigure supply chains.** Manufacturers who provide car componentry need to shift production to electric and green hydrogen vehicles, requiring retooling manufacturing facilities and reskilling workforces. Car retailers need to expand EV model options, adapt marketing measures and adjust customer-facing sales and services practices.
- **Industry must expand battery and fuel cell production.** Coordination between mining industry, industrial production sectors and governments must secure new and further sources of critical minerals and expand domestic manufacturing capabilities.
- **Systemic approach required to accelerate progress and prepare for transformation.** Governments must actively incentivise and mobilise projects, and regulators must ensure the regulatory environment is conducive for the innovative changes required.

Over the next decade, Deloitte Access Economics estimates around \$3.5 billion (net present value) must be transferred to low-emissions transport and infrastructure assets and their associated activity in the mobility system. On this net-zero trajectory, over the next 30 years around \$30 billion in additional capital must flow into low-emissions mobility assets.

A net-zero mobility system will see nearly all passenger cars replaced by EVs, similarly with road and rail freight transport infrastructure. Charging infrastructure will be universally available. Technical advancements and green hydrogen (as a sustainable fuel source) will be available for harder-to-abate sectors such as heavy freight, aviation and shipping. In urbanised areas, walking, cycling, electric micro-mobility, and public transport will increasingly become a preferred, efficient and cost competitive method of private transport.⁷

Figure 8: Capital reallocation required within the mobility system



Source Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.

A new materials manufacturing system

What Australia makes and how it is made has always shaped Australia's economic history. Raw materials manufacturing brings significant value to the economy – currently contributing approximately 61% of Australia's value-added (GVA). However, the system and the growth it brings is not yet decoupled from emissions intensity. Fossil fuels continue to dominate energy inputs to production.

The emissions-intensive nature of many processes across the system are considered 'harder-to-abate' because addressing them poses more technological and commercial challenges compared to other areas of the economy.⁸ Challenges remain in finding and transitioning towards lower-emissions alternatives, increasing energy efficiencies, reducing waste and leveraging circular economy practices. The wide-spread electrification and technological advancement in carbon-capture technologies are critical to an efficient, rapid acceleration to net-zero in the materials manufacturing system.⁹

There are identified opportunities to address industrial emissions through energy and material efficiencies, zero emissions energy and feedstock supply, electrification and other fuel switching, non-energy emissions abatement, and capture or offset of residual emissions. Many of these technologies are mature and ready for wide-spread deployment, but for emerging technologies, further research and development is needed to provide proof of concept or demonstration at scale.

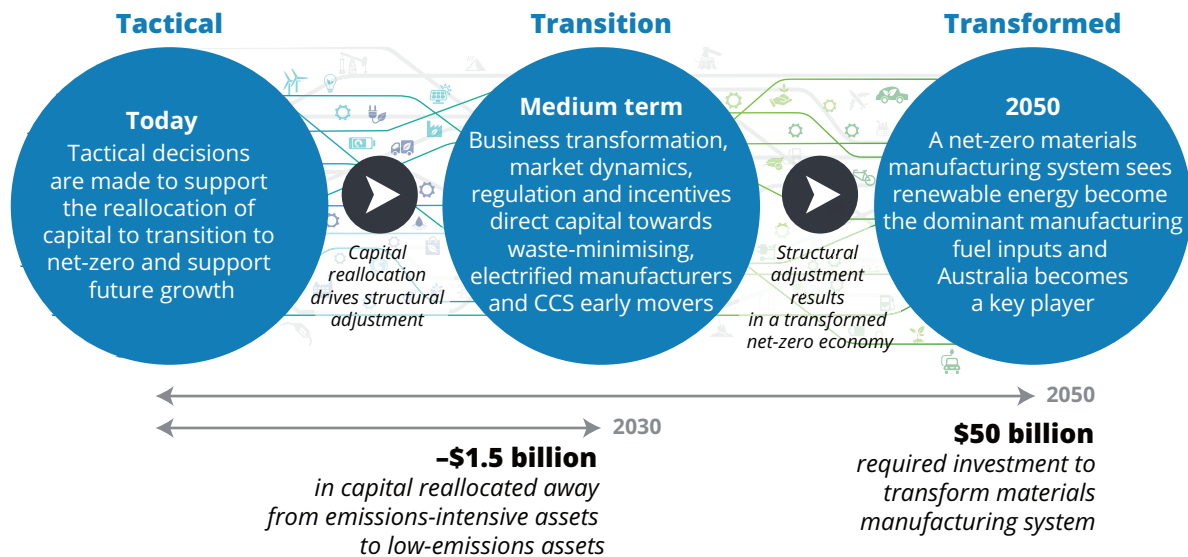
Industrial transitions to net-zero remain complex, and the solutions are sophisticated in nature. The transition to a low-emissions materials manufacturing system requires significant investment, leadership and transformation across key players:

- **Electrification of emissions-intensive industrial processes and use of alternative sustainable fuels (e.g., green hydrogen).** Business competitors, startups, and researchers should work collaboratively to develop, pilot, and deploy viable alternatives, helping to accelerate innovation and diversify risk. Working with participants in the energy system to secure renewable electricity and a significant supply of green hydrogen is critical.¹⁰
- **Businesses need to adopt circular manufacturing processes.** From designing more durable products and improving repairability to reducing energy and materials intensity, optimising supply chains, and reducing waste and expanding recyclability – all efforts will contribute to a more sustainable and efficient manufacturing system, flowing through to the economy. Efforts that will span the entire value chain, from source to end user and from product design to retirement, will be essential

Over the next decade, Deloitte Access Economics estimates around \$1.5 billion (net present value) will be reallocated to low-emissions assets and their associated activity in the manufacturing system. Over the next 30 years, new investment in the order of \$50 billion must flow into low-emissions manufacturing assets on this net-zero trajectory.

A net-zero materials manufacturing system will be defined by different customer demand from today, different raw materials and new ways of manufacturing. Early uptake and effective integration of renewable electricity, electrification and green hydrogen, and widespread deployment of low-emissions technologies will help achieve cost competitiveness and global competitiveness – particularly in the manufacture of cement, steel, aluminium and other harder-to-abate heavy sectors.

Figure 9: Capital reallocation required within the raw materials manufacturing system



Source Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.

A new food and land use system

The food and land use system encompasses the various purposes of land and every element of the food supply chain. It makes a critical contribution to basic human necessities like food and shelter, but also contributes significantly to greenhouse gas emissions. Agriculture is Australia's largest methane emitter, with livestock ruminants the main contributor.¹¹ 30% of Australia's food goes to waste,¹² and it is the only developed country on the WWF's list of global deforestation fronts.¹³ These factors underscore the need for transformative change to achieve emissions reduction in the food and land use system.

Transitioning the food and land use system to net-zero is not without challenges. Australia's current conservation efforts, agricultural history and ingrained dietary habits are not suited to deep decarbonisation. There must be a reversal in the pattern of deforestation, as well as shifts in consumer preferences, farming and food waste. Changing institutions, as well as new technologies and markets will drive adjustments that will gear the food and land use system for a decarbonised economy without compromising on growth.

The food and land use system underpins the health of an economy and its people. While the system has started to realise the necessity of net-zero, change must accelerate for the system to move onto a clean growth trajectory. Capital reallocation can support this transformation, which will be characterised by:

- **Regenerative land use practices that must be developed and deployed on an unprecedented scale.** Agricultural practices like minimum tillage, nutrient cycling and agroforestry require capital provision to scale across Australian agriculture. These shifts can be complemented by technological advancements that improve efficiency and crop productivity. Similarly, afforestation must replace deforestation, with capital investment essential to scale the carbon offset markets that will incentivise this behaviour.
- **Dietary shifts reducing consumption of emissions-intensive food and products, towards sustainable options.** Established consumer preferences mean this shift will lean on capital to develop viable alternatives that align to consumer preferences and market these products widely and effectively.

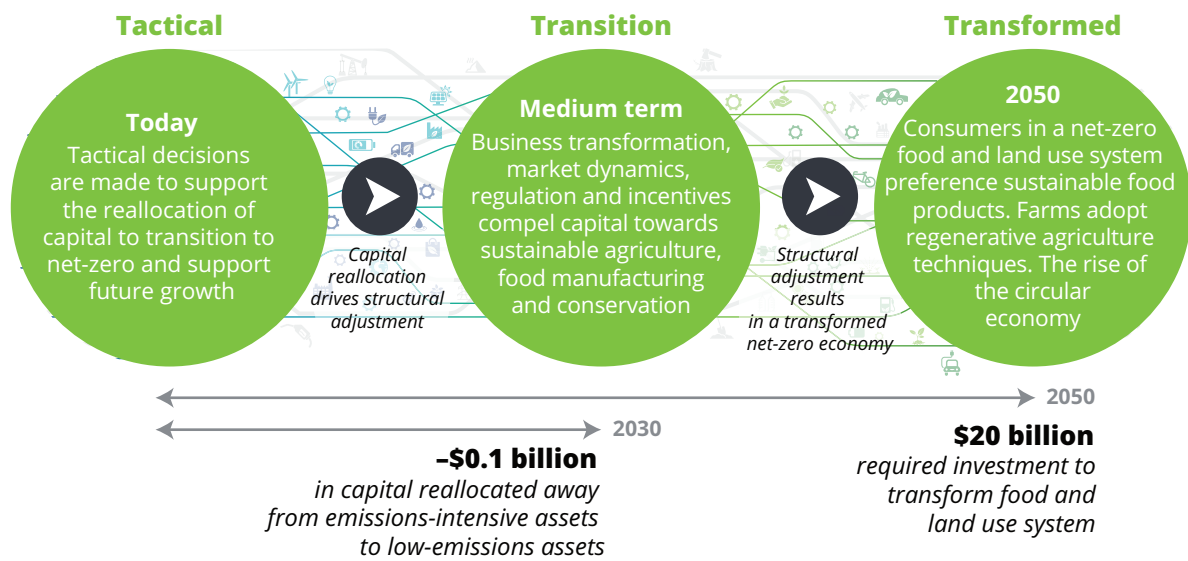
Food waste reduction across the food and beverage supply chain. Governments can set waste reduction standards and targets, but across the economy, greater funding for research and development will be required to support solutions enabling efficiency, monitoring and data transparency across the supply chain. In turn, these developments catalyse food waste – and emissions – reduction.

Food and land use is a critical system not only for growth, but general well-being. It provides the basis for nutrition and shelter, but its value comes at an emissions premium. Over the next decade, Deloitte Access Economics estimates around \$0.1 billion (net present value) must be reallocated to low-emissions assets and activity in the food and land use system.

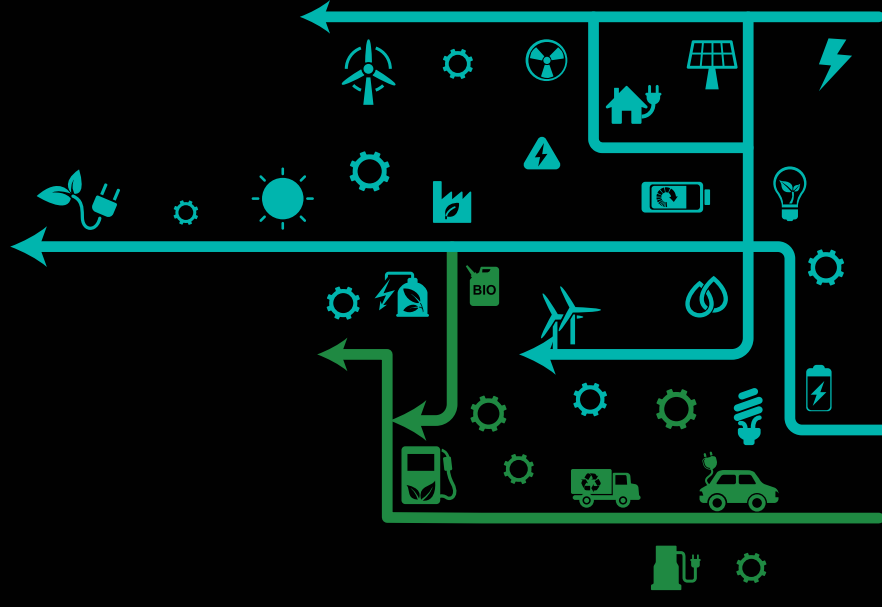
Around \$20 billion in additional capital must flow over the next 30 years into low-emissions food and land use assets to meet Australia's net-zero target.

A low-carbon food and land use system may have a different composition to today's system, but it will continue to make a significant contribution to the economy. Alternative protein sources may lead to reduced emissions from production of protein-based foods such as red meat and regenerative farming and food waste reduction will improve economic and environmental outcomes.

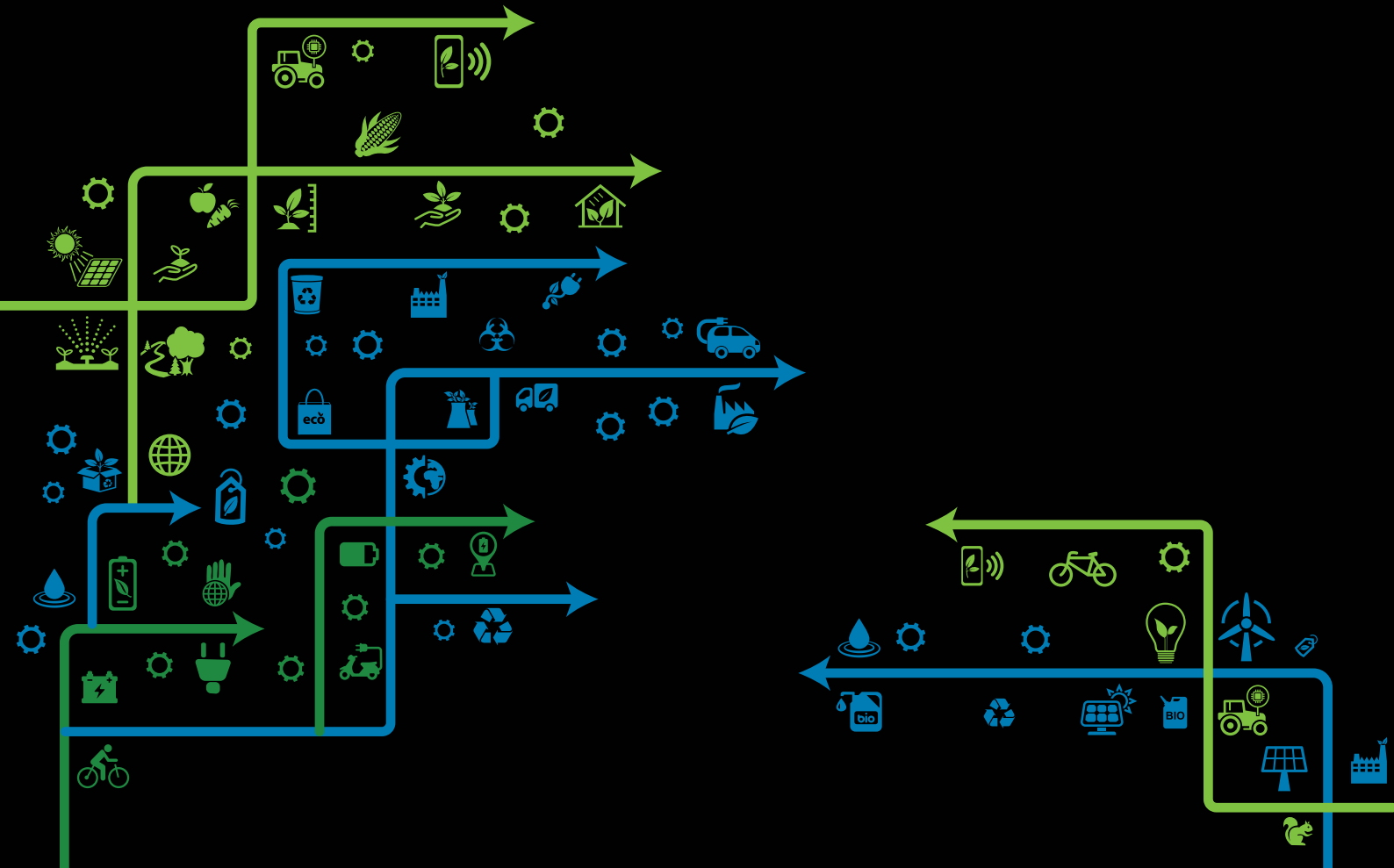
Figure 10: Capital reallocation required within food and land use system



Source Deloitte Access Economics D.CLIMATE modelling. Note: all figures are in net present value terms.



Accelerating system transformation



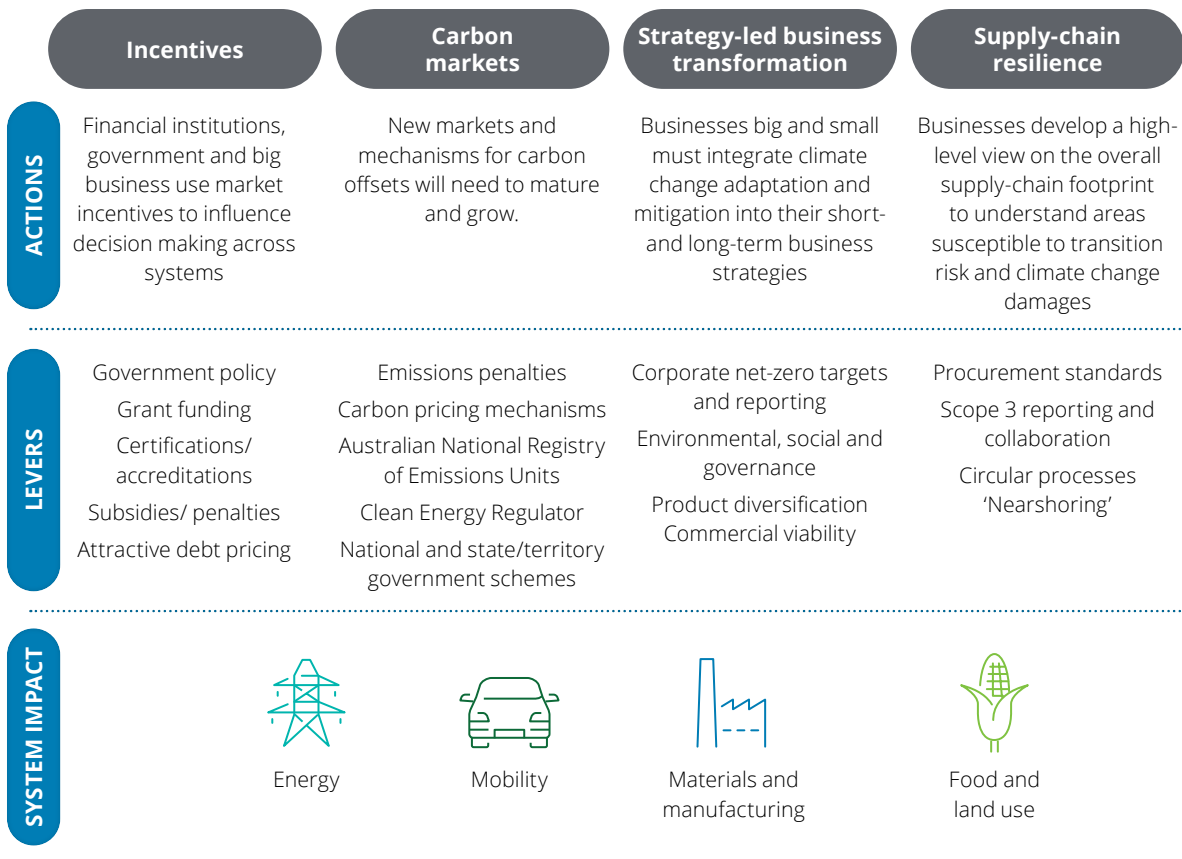
Action on climate change presents both risks and opportunities for the Australian business landscape. The opportunities relate to achieving a new competitive edge through the creation and adoption of decarbonisation activities (e.g. new carbon offset markets). Risks relate to the physical and transition risks of climate change – both of which carry significant economic implications. Managing these risks requires the coordinated reallocation of capital via actions, levers, and enablers to achieve net-zero by 2050.

There are four actions areas that will influence the Great Reallocation and decision making within and across Australia's systems. The actions – market incentives, carbon markets, strategy-led business transformation and supply-chain resilience – work to ensure that financial risks are mitigated and capital flows to areas that support system transformation.

The actions required to transform systems in an efficient and coordinated way are communicated through the following framework, which has two core components:

- **Actions:** broad group of interventions that reallocate capital across systems to support a net-zero transformation.
- **Levers:** mechanisms enacted by government, regulators, financial institutions (such as banks) and businesses to influence action outcomes.

ACTION AREAS TO REALLOCATE CAPITAL ACROSS THE SYSTEMS



Transformation incentives

Incentives encourage system transformation through making activities that support a net-zero future more attractive, relative to activities that do not (i.e. investment in fossil fuels). This can either be through a reward mechanism (e.g. government grant to encourage the commercialisation of green technologies) or a penalty mechanism (e.g. a higher royalty to government). Incentives are often delivered by those who have a greater understanding of climate risks such as government, regulators, and financial institutions (such as banks and superannuation funds), who use this information to **influence decision making at the micro-level**.

Incentives will play a key role in getting the Great Reallocation, where optimal capital reallocation is essential to achieving Australia's net-zero commitment. In the absence of well-structured market incentives to

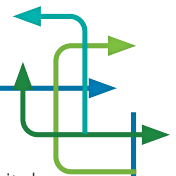
help individual business make good decisions, climate change risks could result in an increase in defaulted loans, stranded assets, bankrupted businesses and a stalled transition to net-zero – further increasing the cost of the transition.

The success of the initiatives designed to transform systems to becoming net-zero is dependent on government, business and consumer appetite to create and adopt the initiatives and for the scale and timing of the initiatives to be aligned to the requirements of the transformation. All aspects of the below list influence the success of incentives at the system level; however, the enablers below have been identified as the key enablers required to transform the system.

Incentives for transforming the mobility system

Incentives that will support the transformation of the mobility system are grant funding and/or cheaper capital (competitive borrowing rates) for R&D in emerging technology/processes (e.g. green fuels and steel) and subsidies for electric vehicles and supporting infrastructure (for example). Where there is a lack of coordination within the mobility system, price signals could be confusing to investors and increase uncertainty. An example of this in practice is the NSW Electric Vehicle Strategy, which coordinates rebates, the phased removal of stamp duty for EVs, EV targets for NSW Government fleet, incentives for council and private fleets and major investment to ensure widespread, world-class EV charging coverage.

Incentives are not the only lever that can be used to transform the mobility system – new markets, business transformation and supply-chain resilience can also work effectively with incentives to reduce uncertainty if they encourage decarbonisation activity.



Carbon markets

Achieving net-zero relies on the ability of Australia to offset hard-to-abate sectors (e.g. heavy industry and transport), as well as significantly reducing emissions. As a result, new markets exist for Australian carbon credit units (ACCUs). Carbon offsets, measured using ACCUs, are the currency and supply across three key markets – including the largest, the Emissions Reduction Fund (ERF). One ACCU is equivalent to the abatement or sequestration of one tonne of emissions, and has a price attached. Projects that generate ACCUs can be developed by businesses, local councils, state governments, landowners or property managers – any party committing to abating or sequestering carbon. Carbon offsets are recognised financial assets, which can be used as security for a loan or other obligation, as well as offsetting emissions.

In the 12-months to September 2021, the supply of ACCUs doubled. Expanding and maturing this market

requires a continued increase in supply – provided by the pipeline of offset projects registered in the ERF.

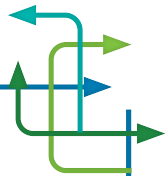
The global carbon market will continue to evolve and expand over time, as barriers to entry are reduced, trading becomes easier, prices are more transparent, and more businesses participate in markets. Australia's connection to the global market will spur the creation of new assets and products and further build out Australia's emerging offset industries such as carbon capture and storage and carbon farming.

The success of Australian offset markets will be enabled through technology development to feed into upscaling of carbon credit supply (e.g. CCS creation of carbon sinks); business and government appetite to contribute to supply (through projects) and trade the credits in local and international markets. To ensure that ACCUs are adopted in global markets, the timing and scale of expansion is critical.

Carbon markets for transforming the food and land use system

The establishment of the ERF and international voluntary markets has created new industries within the food and land use system. The growth of offset markets and, subsequently, industries that contribute to supply such as afforestation / reforestation, blue carbon, carbon farming and vegetation and savanna burning (for example), will be used to transform the structure of the system – reducing emissions and creating new sources of growth.

Emerging technologies are also contributing to the acceleration of carbon markets globally. Carbonplace, for example, is a global voluntary carbon market technology platform being developed to provide settlement infrastructure and systems for marketplaces and exchanges. The platform, formed by a group of banks including NAB in Australia, seeks to strengthen the growing voluntary carbon market.



Strategy-led business transformation

Achieving net-zero requires all businesses to have an integrated approach that links their business strategy with structural shifts and known drivers of change. Environmental, social, and governance (ESG) is often incorporated into business models through minor adjustments (e.g. reducing office energy use), rather than using ESG to underpin all business decisions and investments. To institute an effective and tailored climate change response, businesses need to^x:

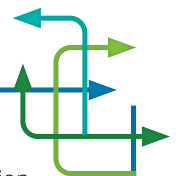
1. Commit to a climate change aspiration, including decarbonisation and adaptation targets aligned with the latest climate science and the Paris Agreement.
2. Develop a climate change strategy based on a holistic understanding of risks and opportunities – for your assets, people, and operations.
3. Align your organisational model so that capital, operating, technology and governance decisions are focused on delivering on your climate change strategy.
4. Enhance organisational capability to enable strategy execution, innovation and transformation
5. Regularly monitor and report performance for all stakeholders and use data-driven insights to adaptively adjust the climate strategy to changing context and stakeholder preferences and requirements.

As part of Step One, targets should be set for what the business can control or influence – Scope 1 and 2 emissions and the broader value chain (Scope 3). Building a greater understanding of Scope 3 emissions is discussed below.

The success of strategy-led business transformation will be enabled through business appetite for change, technology development working to minimise transition costs, and the timing and scale of impact (i.e. a short-term strategy with small decarbonisation initiatives will not be enough to direct capital to where it is needed). Further, to build a strategy that is aligned to the system's transformation there must be perfect information. In the absence of this, a strategy may target the wrong areas and result in an inefficient allocation of capital.

Strategy-led business transformation in the energy system

The magnitude of impact varies by business in the transformation in the energy sector. The strategic direction for most businesses in this system will be to diversify their revenue base, particularly for businesses within the system that have a significant amount of revenue attached to global demand for fossil fuels. An example of this, is a large gas company investing in carbon capture and storage to transform its industry base, in line with the transformation of the system. These strategic decisions at the business level will accelerate transformation at the system level.



^x Deloitte (2021). Five steps to accelerate to zero. <https://www2.deloitte.com/au/en/pages/about-deloitte/articles/five-steps-accelerate-zero.html>

Supply-chain resilience

Supply-chain decarbonisation allows businesses with relatively small direct emissions to have a significant impact on emissions reduction and **systems transformation**. This is essential to systems such as mobility and raw materials manufacturing, which contain hard-to-abate sectors. Decarbonising at the supply chain level will **lower the cost of abatement** incurred by end consumers, as the costs of decarbonising are spread across the value chain. This provides the system-level coordination required to achieve net-zero, while also helping businesses understand their Scope 3 emissions exposure to mitigate future risks.

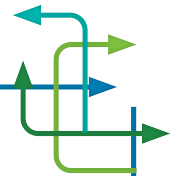
It is expected that even a slight change in how particular goods and services are procured would make a significant change to Australia's Scope 3 emissions. Similarly, changes to business operations and supply chain reporting would have a significant impact on supply chain emissions reduction.

These changes may include collecting supplier emissions data and working with suppliers to reduce emissions in line with targets; revising project design choices; collaborating with suppliers to co-fund abatement; and reviewing geographic sourcing strategies.^{xi}

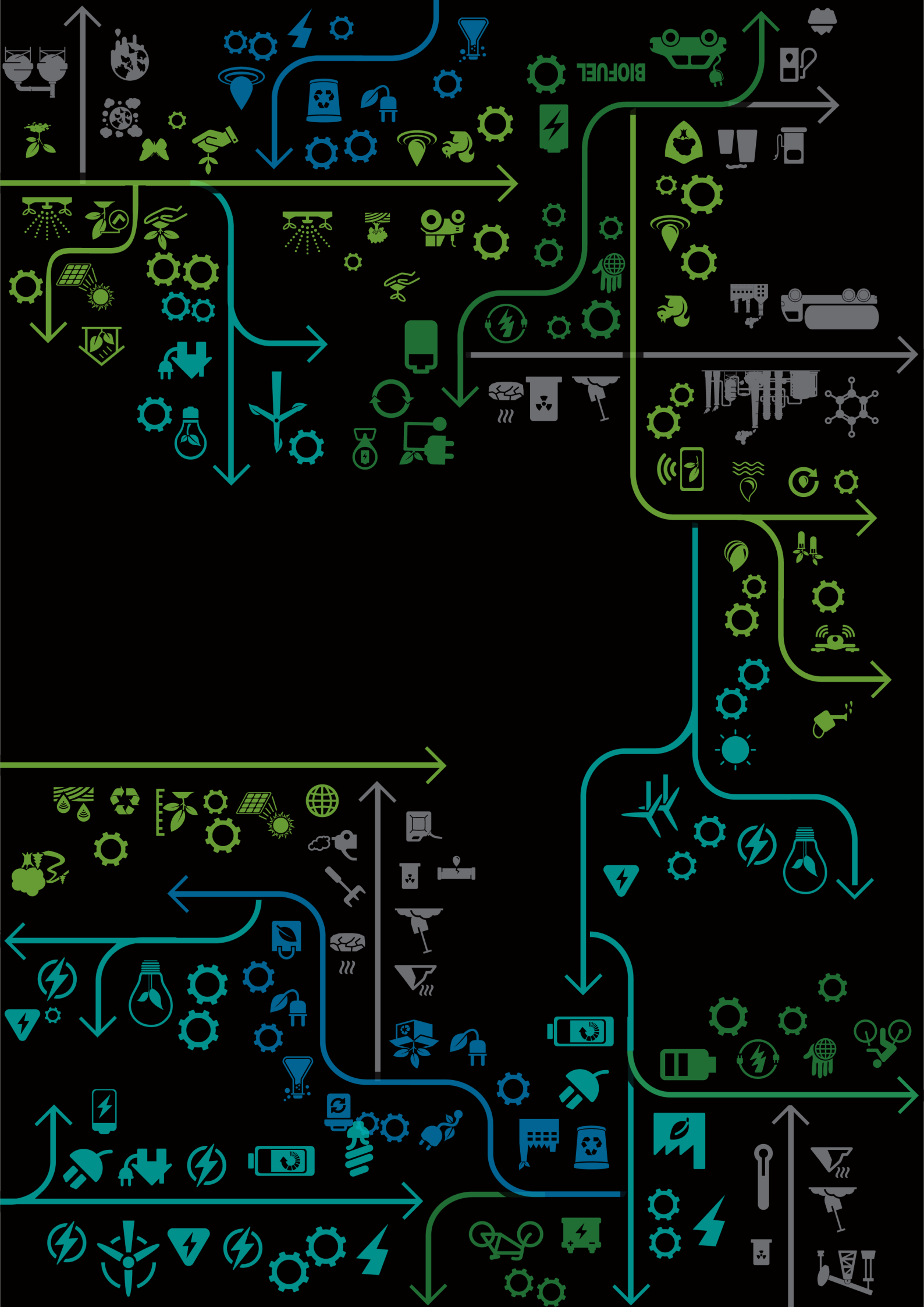
These changes will be enabled through business appetite, which would likely be informed by a change in consumer preferences towards low-emissions products and services. Technology development would decrease the cost of abatement and increase the transformation of hard-to-abate sectors (e.g. steel to green steel). As with the other actions, the timing and scale of impacts to business operations and supply chain reporting will accelerate the system's transformation.

Supply-chain resilience within the raw materials manufacturing system

Governments are a dominant buyer in heavy industry sectors such as cement and steel. In these sectors, a change in procurements standards, for example, by applying a 'green equivalent mandate' (when substitutes are available) will facilitate a reallocation of capital away from emission-intensive products and towards low-emissions heat, new processes, carbon capture and green fuels. Collectively, businesses can make a significant impact on the transformation of supply chains when they are all working towards the common goal of decarbonisation. The costs of abatement will be significant for businesses (end users) within the raw materials manufacturing system. Spreading the costs of decarbonising across the value chain will accelerate the rate of decarbonisation of this sector.



xi World Economic Forum (2021). Net-Zero Challenge: The supply chain opportunity. http://www3.weforum.org/docs/WEF_Net_Zero_Challenge_The_Supply_Chain_Opportunity_2021.pdf



Finance, innovation and business transformation are creating Australia's new low-emissions systems



Energy system

Making a difference on the road to clean energy

The transition underpinning Australia's sustainable future requires a whole-of-economy approach powered by the widespread decarbonisation of the energy supply chain.

For IGO Ltd, the lightbulb moment came in 2017 when the West Australian diversified miner changed strategy to focus solely on metals critical to clean energy.

As well as operations in nickel, copper and cobalt, IGO has recently moved into lithium with stakes in the Greenbushes lithium mine and the Kwinana lithium hydroxide refinery joint venture. These investments support the supply of high-grade materials vital to batteries for electric vehicles and more, while also providing local employment and growth.

"The most exciting part is we are making a difference," says CFO Scott Steinkrug. "It's something that's part of our DNA - the exploration, discovery and development of those metals that are critical for clean energy."

"Our customers are also getting more and more focused on where they get their supply from - so provenance is hugely important. Australia has a very well-recognised name for not only having products mined safely, but ethically as well, and that is a big focus for us."

IGO is also working to transform operations to be carbon neutral by 2035 using a range of measures to lower its footprint year on year.

NAB Corporate and Institutional Banking's Peter Williams is Director and Sector Head for Metals and Mining. He says IGO's ongoing innovation and focus makes for an exciting business upstream in the overall energy system.

"IGO are at the leading edge of supporting the minerals which support decarbonisation through batteries and storage," Williams says. "They are now producing battery grade lithium hydroxide for electric vehicles and the accelerated growth in demand for EVs makes this a very exciting road to be on."

Source: Interview with IGO Ltd and NAB



New mobility system

On track for sustainable transport

As a major part of Sydney's transport, Reliance Rail is playing its part in decarbonising Australia's mobility system through financial innovation that sets ambitious targets for reducing energy and water usage for its electric fleet and maintenance centre.

The landmark \$1.8 billion green sustainability-linked loan (GSLL) is set up as a 21-year refinancing package certified as "green" by the Climate Bonds Initiative under its Low Carbon Transport criteria, with funding margins linked to sustainability improvements.

"The targets are very ambitious but they are relevant and material and will have a real impact for our project," says Reliance Rail CFO Louise Iida.

Reliance Rail formed in 2006 as a public private partnership (PPP) with the New South Wales government, supplying and maintaining rolling stock that today makes up about a third of the Sydney Trains suburban passenger fleet and almost half of total passenger journeys.

The deal has the potential to make a significant

contribution to the sustainability of the state.

"This GSLL provides an example of the sustainability opportunities out there for mature PPPs," Iida says. "It has shown what is possible if we proactively seek solutions and just as importantly, that our lenders, investors and partners are also eager for opportunities to collaborate on sustainability improvement."

NAB acted as joint sustainability co-ordinator, lender and swap provider for the deal and assisted in developing the green and sustainability-linked framework and certification of the loan.

NAB Director, Sustainable Finance, James Waddell worked on the transaction and says an essential part of working with customers is to identify KPIs that represent authentic risks to the business and ensure sustainability targets align to economy-wide decarbonisation ambitions.

"It means Reliance Rail is committed to reducing water and carbon intensity of its trains and maintenance facility which is fantastic," Waddell says.

Source: Interview with Reliance Rail and NAB





Raw materials manufacturing system

Tech investment drives future steel

Steel is one of the hard-to-abate industries vital for the global economy that will need significant technology breakthroughs and investment to achieve a low-emission transition.

With the 1.8 billion tonnes of steel manufactured globally each year expected to grow by as much as a third by 2050, steel producers are looking at the potential of green hydrogen and more as they progress decarbonisation targets and goals.

“Big, commercial-scale breakthroughs in technology will be the game-changer for the steel industry,” says BlueScope Managing Director and CEO Mark Vassella.

“It’s going to take investment in renewables, in infrastructure, in renewable energy storage, in research and development and the discovery of new technologies.

“A potential pathway is direct reduced iron produced using green hydrogen. It has huge potential, so we’re exploring how to make it practically possible.”

BlueScope is collaborating with global miner Rio Tinto on developing low emissions processes and technologies across the steel value chain, through iron ore processing, iron and steel making and other related technologies.

The project includes looking at low emissions iron feed for consumption at BlueScope’s Port Kembla Steelworks made from Rio Tinto’s Pilbara iron ores – something that is not yet technically and commercially possible. The aim is to use green hydrogen from renewable electricity to do it.



“It’s really important for Australia’s future that we create that technology,” Vassella says.

NAB is a key relationship bank for BlueScope and plays a fundamental role in supporting companies in these hard-to-abate sectors that the economy relies on as it progresses towards net-zero by 2050.

NAB Relationship Manager, Corporate and Institutional Banking, Kevin Harkness, says the bank is determined to work with customers to help their transition plans. “As these new technologies emerge, BlueScope will likely need a lot of capital for investment”.

Financial institutions such as NAB are crucial in ensuring that progress towards net-zero is delivered at pace and scale.

Source: Interview with BlueScope and NAB



Food and land use system

Pasture innovation for a changing world

One of the greatest net-zero carbon challenges in food production comes from the emissions generated by grazing animals.

Innovations in agricultural technology have an important role in climate mitigation action. New forms of legume pasture, for example, can potentially reduce methane from livestock while improving soil quality and productivity.

“Farm animals such as cattle, sheep and goats produce methane emissions,” says Agrimix director Nick Kempe. “We have data that shows our pasture legume reduces methane in grazing animals.”

The Agrimix legume, called Progardes® Desmanthus, was developed with researchers from James Cook University and, among other benefits, helps feed nitrogen into the soil to grow more grass.

“With more ground cover, you’ve got cooler, more hydrated soils, a better environment for cattle and improved profitability for the producer,” Kempe says.

Better grass and soil can also help in drawing more carbon out of the atmosphere to be stored in the ground – a soil carbon sequestration process and a form of greenhouse gas mitigation.



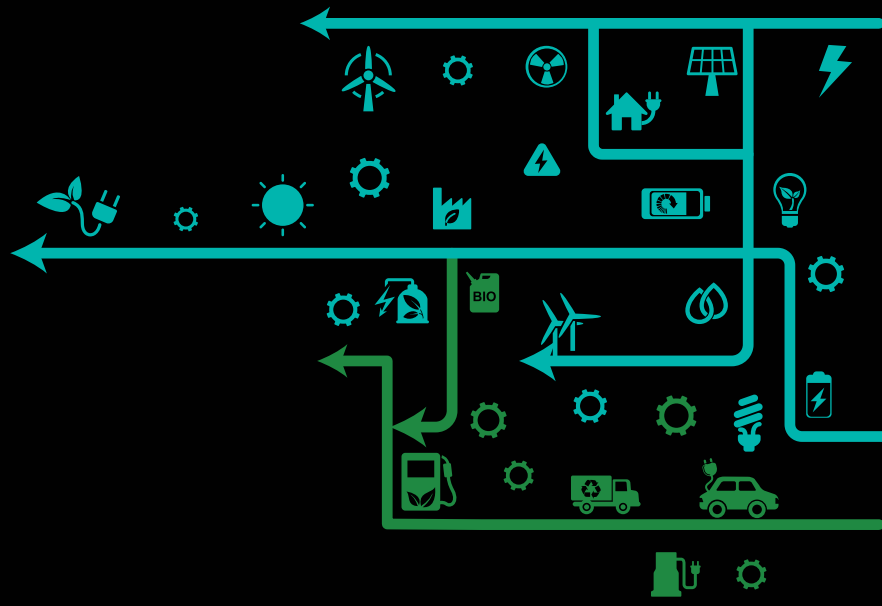
Agrimix is leading a three-year Cooperative Research Centres project that brings together beef producers and leading research institutions to find new legume varieties and ways to increase livestock productivity across Northern Australia.

NAB recently financed speciality scientific equipment to help with measurements in the research.

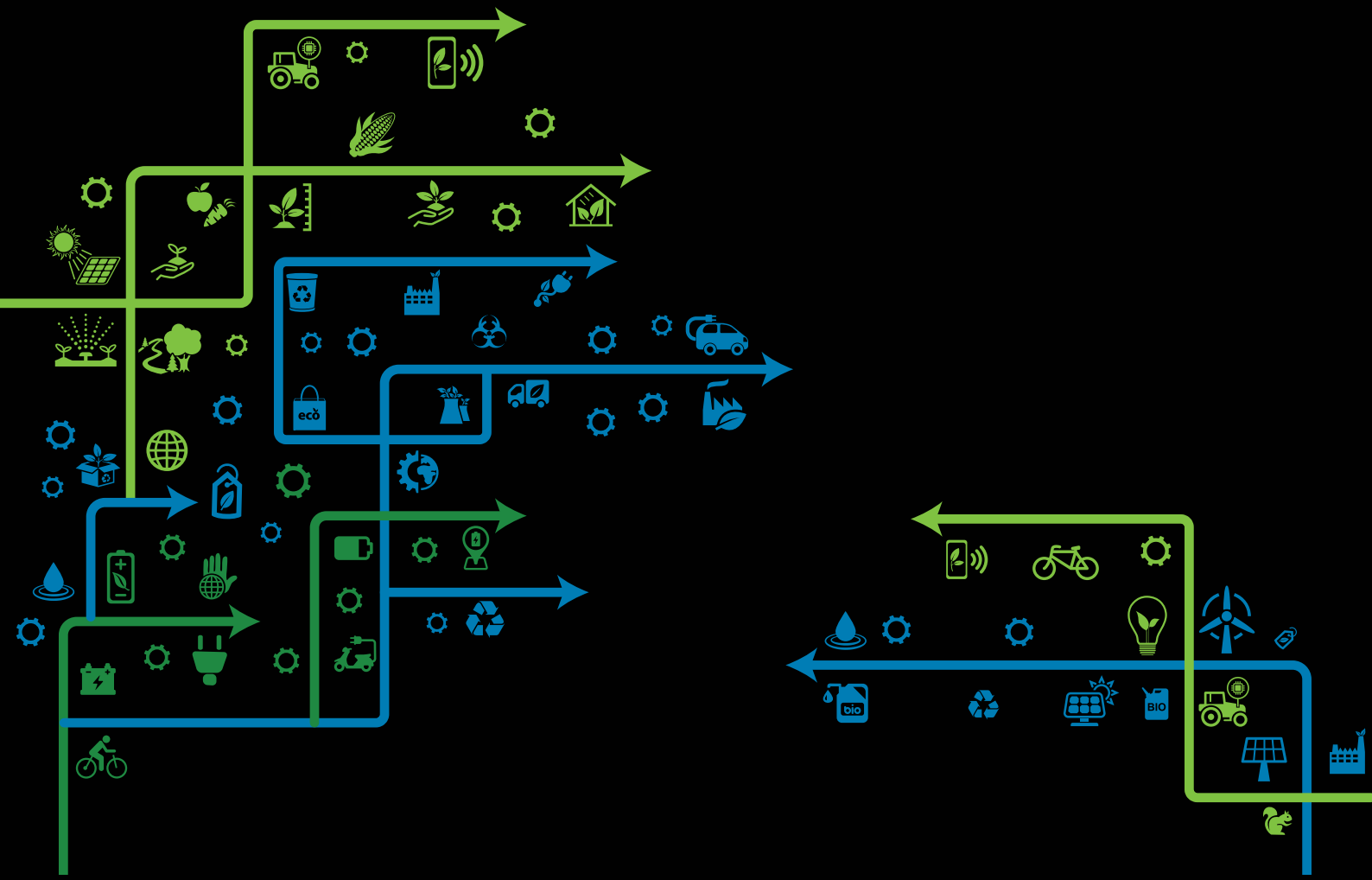
NAB Agribusiness Manager Coen Heslop says Agrimix is a leading example of a business whose innovation is finding commercial opportunity in helping Australia to transition to net-zero by 2050.

“Innovators like Agrimix highlight the benefits and importance of redirecting investment to support Australia’s transition to net zero,” Heslop says.

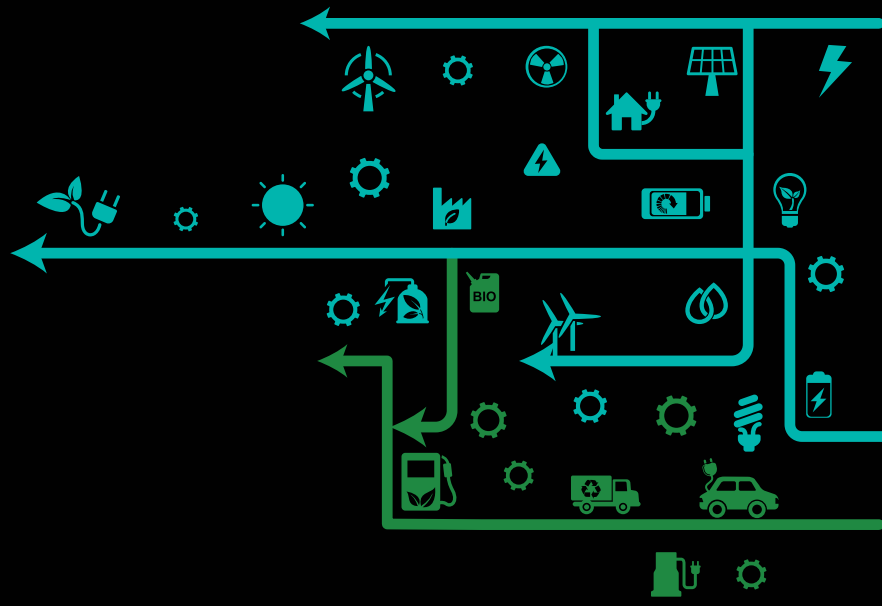
Source: Interview with Agrimix Ltd and NAB



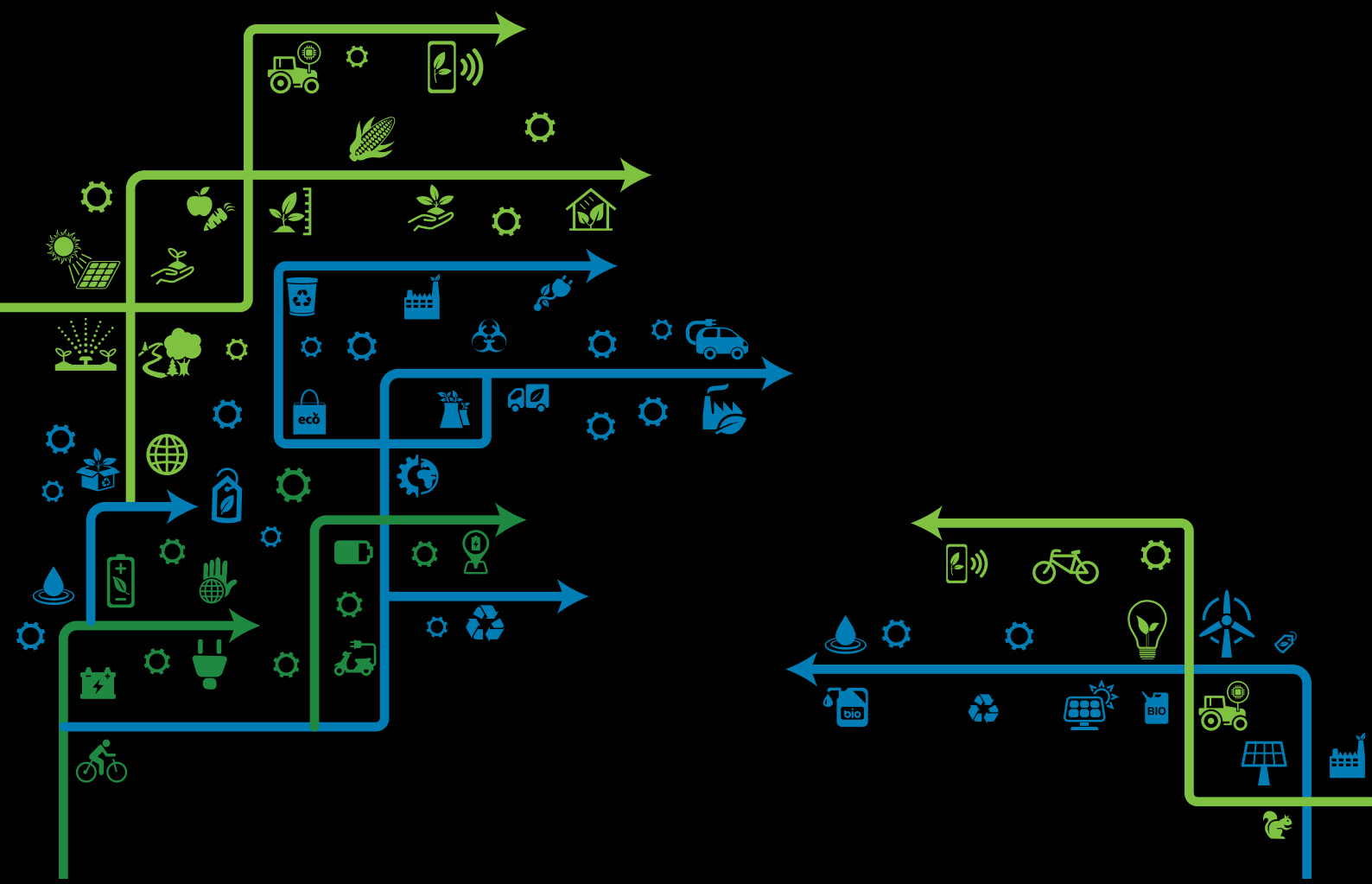
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Technical appendix



What makes the numbers?

The analysis undertaken by Deloitte Access Economics looks at **two core economic concepts** throughout the report.

1. Future economic growth

- The analysis looks at a future economic growth path (as measured by Gross Domestic Product) for Australia that is net-zero domestically by 2050, in line with a global economy that meets net-zero by 2050.
 - This scenario limits global average warming to ‘well below 2°C’ (as close to 1.5°C as possible).
 - The scenario presents results compared to an Australian economy and global economy that is not net-zero and global average warming is around 3°C.
- The scenario results are modelled using Deloitte Access Economics’ in-house Regional Climate Integrated Assessment Computable General Equilibrium Model (D.Climate). Accordingly, these results are long-term scenario outlooks and do not represent forecasts.

2. Capital or ‘investment’ in the future economy

- In the net-zero economy, the analysis looks at capital or ‘investment’ in the Australian economy. This concept of ‘capital’ or ‘investment’ also relates to Gross Domestic Product.
 - The interpretation of the ‘capital’ or ‘investment’ numbers relates specifically to the ‘real’ Australian economy and does not represent the financial side of the economy.
 - This means the results do not project or account for short-term, financial interactions in the same way other macroeconomic models or forecasts do.
 - The results are therefore not comparable to long-term investment forecasts (e.g. \$X billion is forecast to be invested into ABC company due to a net-zero economy).
 - The results in the report are, however, complementary to such financial forecasts as they relate to the magnitude of economic change that would likely stimulate or require such financial investment if similar macroeconomic parameters are assumed.

- The analysis also looks at the way this capital or investment changes as the economy becomes net-zero. It looks at both the total level of investment and the changes to that level of investment due to net-zero.
 - When looking at the **total level of investment**, this refers to the composition of the investment, or what is making up the total level and how has that changed due to the economy becoming net-zero. This is referred to as capital or investment ‘reallocation’.
 - When looking at the **change to the total level of investment**, this is about if the level is going up or down over time due to net-zero. This is the difference in investment between the economy being net-zero or not.

These **two core concepts produce three key numbers** referred to in the report Insight Summary:

- **\$420 billion** in new investment (capital) is required in Australia as it becomes net-zero to 2050.
 - This figure is a **change in the level** of capital investment.
 - This investment is therefore ‘new’ and is a result of the economic changes occurring as the economy becomes net-zero (for example, less emissions, technological improvement, new industries like hydrogen scaling up and new job formation).
- Out of the \$420 billion, **\$400 billion** is specifically linked to the four identified economic systems and enabling services that must become low emissions in this future net-zero economy. This means most of the new investment in a net-zero economy occurs in systems that must decarbonise quickly. This figure is also a **change in the level** of capital investment.
- **\$4 trillion** is the total level of investment in Australia as it becomes net-zero to 2050 and specifically relates to the four identified economic systems that must become low emissions. This includes both new and reallocated capital investment across the four systems as they decarbonise over time.

These core economic concepts also support the analysis in the full body of the report, where they are typically referred to as either ‘new investment’ or ‘reallocated investment’ to distinguish the concepts.

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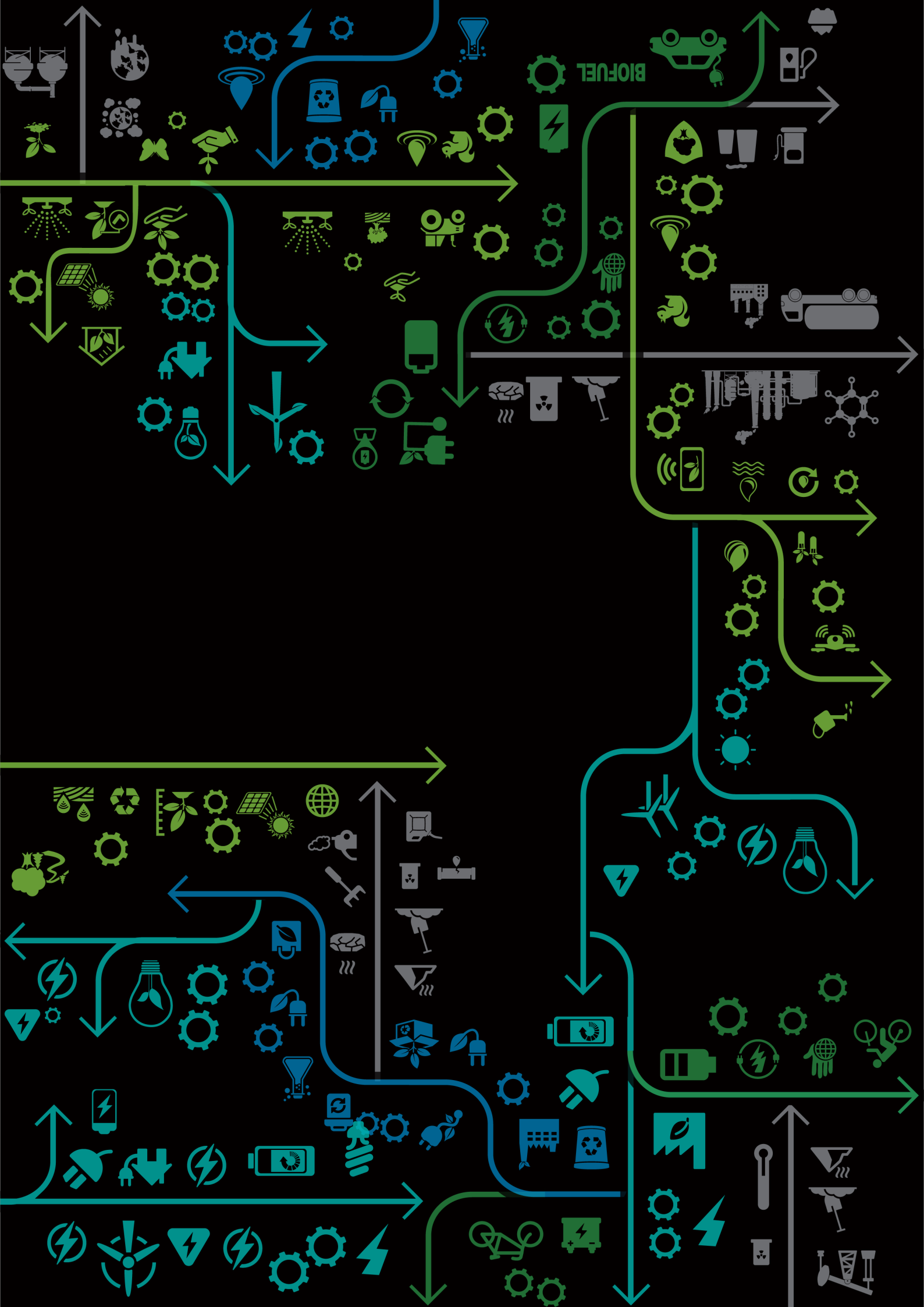
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